

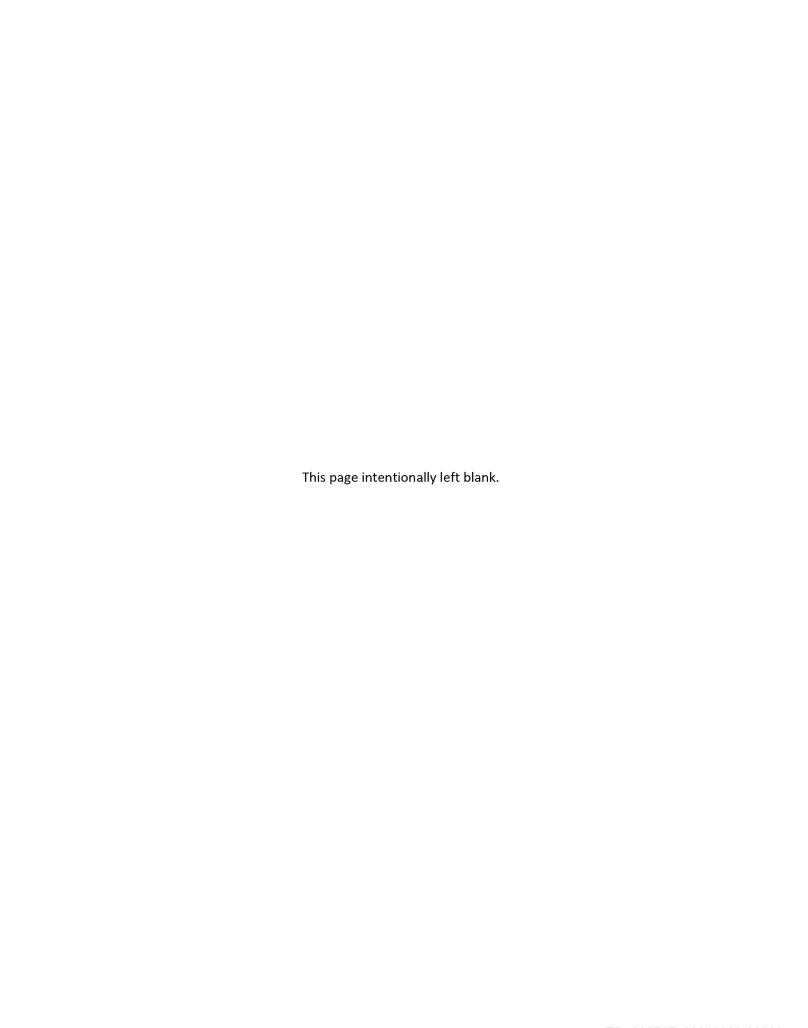
Base Realignment and Closure Program Management Office West San Diego, California

### Draft

# Parcel G Removal Site Evaluation Sampling and Analysis Plan

Former Hunters Point Naval Shipyard San Francisco, California

August 2018



SAP Worksheet #1—Title and Approval Page



Base Realignment and Closure Program Management Office West San Diego, California

### Draft

# Parcel G Removal Site Evaluation Sampling and Analysis Plan

Former Hunters Point Naval Shipyard San Francisco, California

August 2018

# **Approval Signatures**

**Review Signatures:** 

The following person(s) hereby state that they have reviewed this document and approved this document.

anta Dodso-	8/15/2018
Anita Dodson/CH2M HILL, Inc. Program Chemist/Date	
Theresa Rojas, CQA CQMN/CH2M HILL, Inc. Corporate Qual	ity Assurance Manager/Date
Other Assessed Classed	
Other Approval Signatures:	
Joseph Arlauskas/Naval Facilities Engineering Command So	

# **Executive Summary**

This document presents the Uniform Federal Policy (UFP) Sampling and Analysis Plan (SAP) for the radiological investigation at Parcel G at Hunters Point Naval Shipyard (HPNS), located in San Francisco, California. This document was prepared in accordance with the Department of the Navy's (Navy's) UFP-SAP policy guidance to help ensure that environmental data collected are scientifically sound, of known and documented quality, and suitable for intended uses. The laboratory information cited in this SAP is specific to GEL Laboratories, LLC in Charleston, South Carolina. If additional laboratory services are requested requiring modification to this SAP, revised SAP worksheets will be submitted to the Navy for approval.

Sites that will be addressed under this SAP include former radiologically impacted areas in Parcel G, which occupies 40 acres in the middle of HPNS. Radiological surveys and remediation were previously conducted at HPNS as part of a basewide time-critical removal action (TCRA) in accordance with the Action Memorandum (Navy, 2006). Tetra Tech EC, Inc. (TtEC), under contracts with the Navy, conducted a large portion of the basewide TCRA from 2006 to 2015. There have been various allegations of data manipulation or falsification committed by TtEC employees and their subcontractors during the TCRA. An independent third-party evaluation of previous data found evidence of manipulation and falsification at Parcel G (Navy, 2017, 2018a). As a result, the Navy will conduct investigations at radiologically impacted soil and building sites in Parcel G that were surveyed by TtEC.

The purpose of the investigation presented in this SAP is to determine whether current site conditions are compliant with the remedial action objective (RAO) in the Parcel G Record of Decision (ROD) (Navy, 2009). The RAO for radiologically impacted soil and structures is to prevent exposure to radionuclides of concern (ROCs) in concentrations that exceed remediation goals (RGs) for potentially complete exposure pathways. Additional reference background areas (RBAs) will also be identified to confirm, or update as necessary, estimates of naturally occurring and man-made background levels for ROCs not attributed to Naval operations at HPNS.

The approach for collection and evaluation of data is based on the Parcel G ROD (Navy, 2009) and the Basewide Radiological Management Plan (TtEC, 2012). For soil, a phased approach was designed based on a proposal by the regulatory agencies. For buildings, an approach was designed based on regulatory comments on an initial draft work plan to conduct surveys based on the Parcel G ROD. Because the survey design and implementation methods in this SAP are based on the Basewide Radiological Management Plan (TtEC, 2012) and compliance with the RGs in the Parcel G ROD, only applicable elements of the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (USEPA et al., 2000) are incorporated.

The sampling and analysis activities at Parcel G will be conducted in accordance with this SAP, the separate Parcel G Work Plan (Navy, 2018b), and a separate accident prevention plan/site safety and health plan (APP/SSHP). Project requirements, including personnel roles and responsibilities, required training, and health and safety protocols are based on CH2M HILL, Inc. and its subcontractor, Perma-Fix Environmental Services, leading and conducting the field activities. If another contractor performs the field activities, this SAP will be amended with contractor-specific information, as needed.

## Soil Investigations

Soil investigations will be conducted in a phased approach at the following areas in Parcel G:

- Former Sanitary Sewer and Storm Drain Trenches
- Buildings 317/364/365 Former Building Site
- Building 351A Crawl Space

Phase 1 includes investigation of a targeted group of trench units (TUs) and survey units (SUs). Of the 63 former sanitary sewer and storm drain TUs, 21 were selected for the Phase 1 investigation. Of the 28 surface soil SUs

from the Former Building Site and Building 351A Crawl Space, 14 were selected for the Phase 1 investigation. The targeted TUs and SUs were selected based on the highest potential for radiological contamination in light of historical documentation of specific, potential upstream sources or spills, and signs of potential manipulation or falsification from the soil data evaluation (Navy, 2017, 2018b). The Phase 1 soil investigation will include collection of systematic soil samples, gamma scan of 100 percent of soil, and collection of biased soil samples, where necessary, based on the gamma scan measurements.

For TUs associated with former sanitary sewers and storm drains (from 1 to 22 feet deep), 100 percent of the soil will be excavated to the original TU boundaries, as practicable, and gamma scans of the excavated material will be conducted during Phase 1. Excavated soil will be gamma-scanned by one of two methods: 1) Soil may be laid out on Radiological Screening Yard pads for a surface scan, or 2) soil may be processed and scanned using soil segregation technology. Following excavation to the original TU boundaries, additional excavation of approximately 6 inches of the trench sidewalls and floors will be performed to provide ex situ scanning and sampling of the trench sidewalls and floors. For surface soil SUs, a surface gamma scan of 100 percent of surface soil will be conducted as walk-over or drive-over surveys during Phase 1. Systematic and biased samples will be collected from the excavated soil from the TUs, within the surrounding soil of the TUs, and from the surface soil SUs.

Additional soil sampling will be conducted on the remaining 42 TUs and 14 SUs as part of the Phase 2 investigation. For TUs associated with former sanitary sewers and storm drains (from 1 to 22 feet deep), subsurface soil samples will be collected via borings. The borings will be advanced beyond the floor boundary of the trench or to the point of refusal. Gamma scans of the core will be conducted. For surface soil SUs, systematic samples will be collected from underneath the durable cover layers.

The soil samples collected at Parcel G will be analyzed for ROCs.

Soil sampling will be conducted in RBAs to establish representative background data sets for soil ROCs, naturally occurring radioactive material (NORM), radionuclides, and fallout ROCs, for comparison and evaluation of soil data collected from HPNS, including Parcel G. Four onsite RBAs, located at HPNS, and one undisturbed offsite RBA are planned for radiological background characterization. The background characterization will include gamma scans, surface soil sampling, and subsurface soil sampling. Soil samples will be analyzed for ROCs along with NORM radionuclides and fallout radionuclides. The data will be compared and evaluated to provide representative RBA data sets that will be used to evaluate site investigation data to support a final decision on whether residual radioactivity is found to exceed the RGs, thus requiring further remediation.

## **Building Investigations**

Building investigations will be performed at the following structures in Parcel G:

- Building 351A
- Building 351
- Building 366
- Building 401
- Former Building 408 Concrete Pad
- Building 411
- Building 439

Radiological investigations at the buildings will include collection of systematic static alpha-beta measurements; alpha-beta scanning of surfaces; collection of biased static alpha-beta measurement, where necessary based on the alpha-beta scan measurements; collection of swipe samples to assess removable contamination levels; and collection of material samples as needed to further characterize areas of interest.

#### **Data Evaluation**

Data from the radiological investigation will be evaluated to determine whether the site conditions are compliant with the Parcel G ROD RAO. If the residual ROC concentrations are below the RGs in the Parcel G ROD, then the site conditions are compliant with the Parcel G ROD RAO. Various methods will be used to determine whether the residual ROC concentrations are below the RGs:

- Each sample and measurement result will be compared to the corresponding RG.
- Individual samples reporting <sup>226</sup>Ra gamma spectroscopy concentrations greater than the RG for <sup>226</sup>Ra will be analyzed for uranium-238 (<sup>238</sup>U) and <sup>226</sup>Ra using comparable analytical methods. For that specific sample, the <sup>238</sup>U result will be used as a more representative estimate of the background value for <sup>226</sup>Ra, and the alpha spectrometry <sup>226</sup>Ra concentration will be compared to the RG for <sup>226</sup>Ra using the revised background value.

Investigation data may be evaluated against the reference area data to provide a comparison with background. If the investigation results demonstrate that site conditions are compliant with the Parcel G RAO, then a remedial action completion report (RACR) will be developed. The RACR will describe the results of the investigation and will provide a demonstration that the RAO has been met, and that residual radioactivity levels are comparable with background.

If the investigation results demonstrate that site conditions are not compliant with the Parcel G ROD RAO, then the data will be evaluated to determine whether site conditions are protective of human health using the United States Environmental Protection Agency's (USEPA's) current guidance on *Radiation Risk Assessment at CERCLA Sites* (USEPA, 2014a). A removal site evaluation report will be developed to include recommendations for further action.

## Organization of the SAP

This SAP consists of 37 worksheets specific to the scope of work for the Parcel G Removal Site Evaluation. Tables are embedded within the worksheets. Figures are presented at the end of the document. The project scoping meeting minutes are included in **Attachment 1**. The Field Standard Operating Procedures are provided in **Attachment 2**. Laboratory Department of Defense (DoD) Environmental Laboratory Standard Operating Procures are provided in **Attachment 3**. DoD Environmental Laboratory Accreditation Program accreditation letters are included in **Attachment 4**. The technical systems audit checklist is included in **Attachment 5**.

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- 1 Project Scoping Meeting Minutes
- 2 Field SOPs
- 3 Laboratory SOPs
- 4 Laboratory Certifications
- 5 Technical Systems Audit Checklist

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- 10-1 Conceptual Site Model
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Bayview Park Reference Background Area RBA-Bayview

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# Acronyms and Abbreviations

<sup>40</sup>K potassium-40

<sup>60</sup>Co cobalt-60

<sup>90</sup>Sr strontium-90

<sup>137</sup>Cs cesium-137

<sup>212</sup>Bi bismuth-212

<sup>212</sup>Pb lead-212

<sup>214</sup>Bi bismuth-214

<sup>214</sup>Pb lead-214

<sup>226</sup>Ra radium-226

<sup>228</sup>Ac Actinium-228

<sup>228</sup>Th thorium-228

thorium-230

thorium-232

<sup>234</sup>Pa protactinium-234

thorium-234

<sup>234</sup>U uranium-234

<sup>235</sup>U uranium-235

<sup>238</sup>Pu plutonium-238

<sup>238</sup>U uranium-238

<sup>239</sup>Pu plutonium-239

<sup>240</sup>Pu plutonium-240

<sup>241</sup>Am americium

%R percent recovery

APP Accident Prevention Plan

ASTM American Society for Testing and Materials

BEC BRAC Environmental Coordinator

bgs below ground surface
BLTL Business Line Team Leader

BMP best management practice

BRAC Base Realignment and Closure
BSC Background Subtraction Count

CA corrective action

CAS Chemical Abstracts Service

CCV continuing calibration verification

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CDPH California Department of Public Health

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act

CFR Code of Federal Regulations

CH2M CH2M HILL, Inc.

CLEAN Comprehensive Long-Term Environmental Action – Navy

CLP Contract Laboratory Program

cm² square centimeter(s)
cm/s centimeter(s) per second
CSM conceptual site model
DoD Department of Defense
DOT Department of Transportation

dpm/100 cm<sup>2</sup> disintegration(s) per minute per 100 square centimeters

DQA Data Quality Assessment
DQI data quality indicator
DQO data quality objective

DTSC California Department of Toxic Substances Control

EDD electronic data deliverable

ELAP Environmental Laboratory Accreditation Program

EPM Environmental Program Manager

ESU excavated soil unit

FWHM full width at half maximum GEL GEL Laboratories, LLC

GFPC gas flow proportional counting
GPS global positioning system

HP Hunters Point

HRA Historical Radiological Assessment HPNS Hunters Point Naval Shipyard

ICAL initial calibration

ICALE initial calibration – efficiency
ICALV Initial calibration – voltage plateau
ICC instrument contamination check
ICV initial calibration verification
IECV efficiency calibration verification

ID identification keV kiloelectron volt KW Kruskal-Wallis LCL lower control limit

LCS laboratory control sample
LLRW low-level radioactive waste
LRPM Lead Remedial Project Manager

m<sup>2</sup> square meter(s)

MARLAP Multi-Agency Radiological Laboratory Analytical Protocols Manual MARSSIM Multi-Agency Radiation Survey and Site Investigation Manual

MB method blank

MDC minimum detectable concentration

MS matrix spike

MSD matrix spike duplicate

N/A not applicable

NAVFAC Naval Facilities Engineering Command

NAVSEA Naval Sea Systems Command Navy Department of the Navy

NORM naturally occurring radioactive material

NRC Nuclear Regulatory Commission
NRDL Naval Radiological Defense Laboratory

OCII Office of Community Investment and Infrastructure

ORR Operational Readiness Review

PARCCS precision, accuracy, representativeness, completeness, comparability, and sensitivity

pCi/g picocurie(s) per gram pCi/L picocurie(s) per liter

Perma-Fix Environmental Services

POC point of contact PM Project Manager

PPE personal protective equipment

QA quality assurance

QAO Quality Assurance Officer

QC quality control QL quantitation limit

QSM Quality Systems Manual for Environmental Laboratories

RACR remedial action completion report RASO Radiological Affairs Support Office

RAO remedial action objective RBA reference background area

RER relative error ratio
RG remediation goal
ROC radionuclide of concern
ROD record of decision

ROICC Resident Officer in Charge of Construction

RPD relative percent difference
RPM Remedial Project Manager
RSO Radiation Safety Officer
RSY radiological screening yard
RTC Response to Comment

SAP sampling and analysis plan

SB subsurface soil

SCM surface contamination monitor

SFDPH San Francisco Department of Public Health

SFU sidewall floor unit

SOP standard operating procedure

SS surface soil

SSHO Site Safety and Health Officer
SSHP Site Safety and Health Plan
STC Senior Technical Consultant

SU survey unit

TBD to be determined

TCRA time-critical removal action
TSA Technical Systems Audit

TtEC Tetra Tech EC, Inc.

TU trench unit

UCL upper control limit
UFP Uniform Federal Policy

USDOE United States Department of Energy

USEPA United States Environmental Protection Agency

VSP Visual Sampling Plan

Water Board California Regional Water Quality Control Board, San Francisco Bay Region

## SAP Worksheet #2—SAP Identifying Information

Site Name/Number: Former Hunters Point Naval Shipyard (HPNS), San Francisco, California

Operable Unit: Not Applicable (N/A)

Contractor Name: CH2M HILL, Inc. (CH2M)

Contract Number: N62470-16-D-9000

**Contract Title:** Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project

Plan) Parcel G Removal Site Evaluation Work Plan, Former Hunters Point Naval

Shipyard

Work Assignment Number: Contract Task Order Number FZ12

- 1. This Sampling and Analysis Plan (SAP) was prepared in accordance with Naval Facilities Engineering Command (NAVFAC), Southwest Division Work Instructions and the following guidance documents:
  - Guidance for Quality Assurance Project Plans (USEPA, 2002)
  - Uniform Federal Policy for Quality Assurance Project Plans (USEPA, 2005)
  - Guidance on Systematic Planning Using the Data Quality Objectives Process (USEPA, 2006)
  - Quality Systems Manual for Environmental Laboratories, Version 5.1 (DoD, 2017)
- 2. Identify regulatory program:
  - Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
- 3. This SAP is a project-specific SAP.
- 4. List dates of scoping sessions that were held:
  - The Department of the Navy (Navy) Base Realignment and Closure (BRAC) Project Management Office held project kickoff meetings on November 17 and 22, 2016, and a meeting with the regulators, including the United States Environmental Protection Agency (USEPA), California Department of Toxic Substances Control (DTSC), Office of Community Investment and Infrastructure (OCII), San Francisco Department of Public Health (SFDPH), and California Regional Water Quality Control Board, San Francisco Bay Region (Water Board) on December 7, 2016.
  - The Navy assembled a Technical Team (a group of technical experts) that includes representatives from the Navy, USEPA, DTSC, California Department of Public Health (CDPH), and the City of San Francisco The Technical Team conducted an evaluation of previous HPNS data in light of the claims made and is developing an approach for follow up investigations. The Technical Team meets at least bi-weekly to discuss project updates and review documents. To date, several work plan iterations have been submitted and reviewed. For soil, a phased approach was designed based on a proposal by the regulatory agencies on an initial draft work plan. For buildings, the approach was designed based on regulatory comments on an initial draft work plan to conduct surveys based on the Parcel G Record of Decision (ROD). The approaches for soil and buildings are included in the Draft Parcel G Removal Site Evaluation Work Plan, herein referred to as the Parcel G Work Plan (Navy, 2018b), which has been submitted and is currently in review.
- 5. List dates and titles of documents that are relevant to the current investigation:
  - Previous site work relevant to the current investigation is summarized in Table 2-1. Worksheet #10 includes a summary of the findings from previous investigations.

## SAP Worksheet #2—SAP Identifying Information (continued)

Table 2-1. Previous Site Work

Reference Title	Date	Author
Final Historical Radiological Assessment, Volume II, Use of General Radioactive Materials, 1939-2003	2004	NAVSEA
Basewide Radiological Removal Action, Action Memorandum, HPS, San Francisco, California, Revised Final	2006	TtEC
Basewide Radiological Removal Action, Action Memorandum- Revision 2006, HPNS, San Francisco, California	2006	TtEC
Addendum 1 to the Final Sampling and Analysis Plan for the Base-Wide Sewer Systems (Field Sampling Plan and Quality Assurance Project Plan), Base-wide Storm Drain and Sanitary Sewer Removal, HPS, San Francisco, California	2006	TtEC
Base-wide Radiological Work Plan, HPS, San Francisco, California, Revision 1	2007	TtEC
Project Work Plan, Basewide Storm Drain and Sanitary Sewer Removal, HPNS, San Francisco, California, Revision 3	2008	TtEC
Record of Decision for Parcel G	2009	Department of the Navy
Project Work Plan, Base-wide Storm Drain and Sanitary Sewer Removal, HPS, San Francisco, California, Revision 4	2010	TtEC
Basewide Radiological Management Plan	2012	TtEC
Work Plan, Basewide Radiological Support, HPNS, San Francisco, California	2015	TtEC
Radiological Data Evaluation Findings Report for Parcels B and G Soil	2017	Department of the Navy
Building Data Initial Evaluation Report, Draft	2018	Department of the Navy

#### Notes:

NAVSEA = Naval Sea Systems Command

TtEC = Tetra Tech EC, Inc.

- 6. Organizational partners (stakeholders) and connection with lead organization:
  - USEPA Regulatory Stakeholder
  - California DTSC Regulatory Stakeholder
  - CDPH Regulatory Stakeholder
  - California Environmental Protection Agency State Water Resources Control Board Regulatory Stakeholder
  - City of San Francisco Future Property Owner
  - Surrounding HPNS Community Public Stakeholder
- 7. Lead organization:
  - United States Department of the Navy (Navy) NAVFAC Southwest, BRAC Program Management Office
     West
- 8. If any required SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below:
  - No worksheets are excluded from this SAP.

## SAP Worksheet #3—Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
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Kim Henderson	Project Manager (PM)	CH2M	(619) 272-7209	kimberly.henderson@ch2m.com

SAMPLING AND ANALYSIS PLAN (FIELD SAMPLING PLAN AND QUALITY ASSURANCE PROJECT PLAN), RADIOLOGICAL DATA EVALUATION AND CONFIRMATION SURVEY HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA
REVISION 0
JUNE 2017

## SAP Worksheet #3—Distribution List (continued)

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Bob Pullano	Laboratory QAO	GEL	(843) 556-8171	rlp@gel.com	
TBD	Data Validation PM	TBD	TBD	TBD	
TBD	Utility Locator	TBD	TBD	TBD	
TBD	Driller	TBD	TBD	TBD	
TBD	Direct-push Technology Provider	TBD	TBD	TBD	
TBD	Surveyor	TBD	TBD	TBD	

#### Notes:

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TBD cells will be populated with information after personnel are selected, prior to fieldwork.

## SAP Worksheet #4—Project Personnel Sign-off Sheet

Name	Organization/Title/Role	Telephone Number (optional)	Signature/e-mail receipt	SAP Section Reviewed	Date SAP Read
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Kevin Smallwood	CH2M/Field Team Leader	(970) 250-5441			
Mark Cichy	CH2M/Project Chemist	(530) 229-3274			
Monica Calabria	CH2M/Data Manager	(610) 399-3860			
Rachel Zajac-Fay	CH2M/SSHO	(916) 286-0235			
Valerie Davis	GEL/Laboratory PM	(843) 556-8171			
TBD	TBD/Data Validation PM	TBD			
TBD	CH2M/Sampling Personnel	TBD			

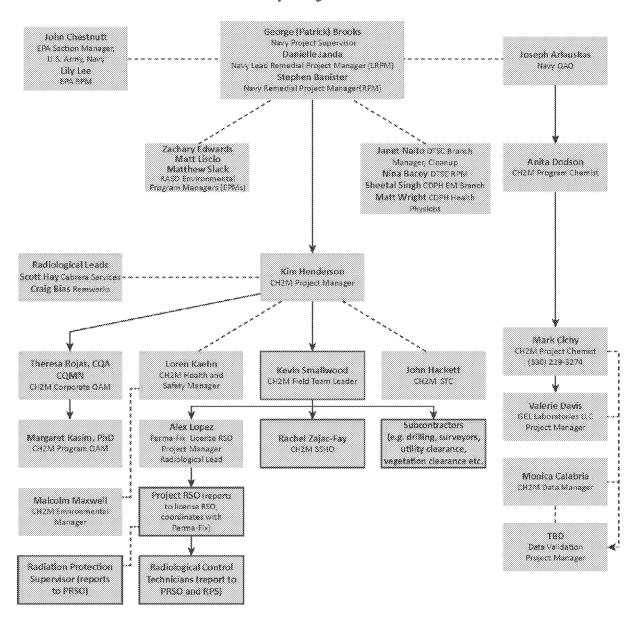
#### Notes:

The sampling personnel will read the appropriate sections of this document before performing activities related to this SAP. The completed sign-off worksheet will be maintained in the project file.

SAMPLING AND ANALYSIS PLAN (FIELD SAMPLING PLAN AND QUALITY ASSURANCE PROJECT PLAN), RADIOLOGICAL DATA EVALUATION AND CONFIRMATION SURVEY HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA REVISION 0 JUNE 2017	
PAGE 22	
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## SAP Worksheet #5—Project Organizational Chart

#### **HPNS Project Organization Chart**



#### LEGEND

Denotes in Field Role

Lines of Authority

Lines of Communication

5865653633380O

## SAP Worksheet #6—Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure (timing, pathway to and from, etc.)
	Navy LRPM	Danielle Janda	(619) 524-6041	
	Navy Project Supervisor	George (Patrick) Brooks	(619) 524-5724	Primary points of contact (POCs) for Navy; can delegate communication to other internal or external
Communication with Navy (lead agency)	NAVSEA RASO, EPM, Health Physicist	Zachary Edwards	(757) 887-7762	POCs. PM will communicate either verbally or by e-mail with earliest schedule possible for fieldwork to commence. Navy will provide PM with written
communication with Navy (icaa agency)	NAVSEA RASO, EPM, Health Physicist	Matthew Slack	(757) 887-4212	instruction to proceed upon completing coordination with Contracting Officer. Navy will notify USEPA, DTSC, CDPH, and SDPH by e-mail or telephone call for significant field changes effecting the scope or
	NAVSEA RASO, EPM, Health Physicist	Matt Liscio	(757) 887-4354	implementation of the design.
Communication with USEPA	USEPA	Lily Lee	(415) 847-4187	Primary POC for USEPA; can delegate communication to other internal or external POCs. Upon notification of field changes, USEPA will review significant field changes. Reports and other project-related information are submitted by the Navy for review and comments by the agency.
	DTSC Branch Manager, Cleanup	Janet Naito	(510) 540-3833	Primary POCs for DTSC; can delegate communication to other internal or external POCs. Upon notification
Communication with DTSC	DTSC RPM	Nina Bacey	(510) 540-2480	of field changes, DTSC will review significant field changes. Reports and other project-related information are submitted by the Navy for review and comments by the agency.
Communication with Water Board	RPM, Technical Lead Staff	Tina Low	(510) 622-5682	Primary POCs for Water Board; can delegate communication to other internal or external POCs. Upon notification of field changes, Water Board will review significant field changes. Reports and other project-related information are submitted by the Navy for review and comments by the agency.

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure (timing, pathway to and from, etc.)
Communication with SFDPH	SFDPH Staff Lead	Amy Brownell	(415) 252-3967	Primary POCs for SFDPH; can delegate communication to other internal or external POCs. Reports and other project-related information are submitted by the Navy for review and comments by the agency.
Communication regarding overall project status and implementation, and primary POC with Navy, USEPA, DTSC, Water Board, SFDPH	СН2М РМ	Kim Henderson	(619) 272-7209	Oversees project and will be informed of project status by the field team. If field changes occur, PM will work with the Navy to communicate in-field changes to the regulatory agencies by e-mail. Materials and information about the project are forwarded to the Navy by the PM.
Communication with the Comprehensive Long-Term Environmental Action – Navy (CLEAN) program	CH2M Deputy Program Manager	Doug Dronfield	(703) 376-5090	Oversees the CLEAN program for CH2M as needed. Will be notified if field changes occur that require program support.
	CH2M Radiological Lead	John Hackett	(303) 589-7217	Contact STC regarding questions/issues encountered
Technical communications for project implementation and data interpretation	Cabrera Radiological Lead	Scott Hay	(702) 236-8401	in the field, input on data interpretation, as needed. STC will have 24 hours to respond to technical field questions as necessary. Additionally, STC will review
	Perma-Fix Lead PM/RSO	Alex Lopez	(970) 778-0449	the data as necessary during report preparation.
Communications regarding the SAP	CH2M SAP reviewer	Janna Staszak	(757) 671-6256	Changes/revisions to the SAP will be reviewed by the SAP reviewer, as soon as possible, and as necessary.
SAP amendments	CH2M Program Chemist	Anita Dodson	(757) 671-6218	Any changes to the SAP are submitted in writing to the Navy QAO, who must approve the changes prior to implementation. The appropriate regulatory agencies will also be notified when SAP amendments are issued.

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure (timing, pathway to and from, etc.)
SAP amendment approvals	Navy QAO	Joseph Arlauskas	(619) 532-4125	Issues final approval of SAP amendments to Program Chemist via signed approval form (portable document format is acceptable). Concurrence from the Navy LRPM/Business Line Team Leader (BLTL).
Communication with Navy QAO	CH2M Program Chemist	Anita Dodson	(757) 671-6218	Quality-related materials and information about the project are forwarded to the Navy QAO by the Program Chemist.
Health and safety	СН2М НЅМ	Loren Kaehn	(208) 383-6212	Responsible for generation of the Health and Safety Plan and approval of the activity hazard analyses prior to the start of fieldwork. The PM will contact the HSM as needed regarding questions/issues encountered in the field.
Health and safety	CH2M SSHO	Rachel Zajac-Fay	(916) 286-0235	Responsible for the adherence of team members to the site safety requirements described in the Health and Safety Plan. Will report health and safety incidents to PM as soon as possible.
Field progress reports	Field Team Leader CH2M	Kevin Smallwood	(970) 250-5441	Daily field progress reports will be prepared by the Field Team Leader and submitted to the PM by phone or e-mail.
Stop work issues	Field Team Leader CH2M	Kevin Smallwood	(970) 250-5441	Field Team leader notifies PM about any stopped work that occurs. All field personnel have stop work authority based on the Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP). Joseph
Stop work issues	Navy QAO	Joseph Arlauskas	(619) 532-4125	Arlauskas, Navy QAO, or representative, has authority to stop work if quality-related compliance issues are identified, or if there is noncompliance with field quality control (QC) protocols, as specified in this SAP.

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure (timing, pathway to and from, etc.)
Revising sampling program (adding or removing sampling location or revising analytical suite)	СН2М РМ	Kim Henderson	(619) 272-7209	Changes to the sampling program are submitted in writing as a field change request or proposed SAP amendment to the Navy QAO, who must approve the changes prior to implementation.
Field deviations from the SAP	Field Team Leader	Kevin Smallwood	(970) 250-5441	Documentation of deviations from the SAP will be made in the field logbook, and the PM will be notified immediately. Deviations will be made only with approval from the PM. The appropriate regulatory agencies will also be notified of significant field deviations from the SAP as appropriate.
Release of field data	Field Team Leader CH2M	Kevin Smallwood	(970) 250-5441	Field data are reviewed by the Field Team Leader and are transmitted by e-mail or hard copy shipping to the PM.
Reporting analytical data quality issues	GEL PM	Valerie Davis	(843) 556-8171	Quality assurance (QA)/QC issues with project field samples will be reported within 2 days to the Project Chemist by the laboratory.
Field or analytical corrective actions (CAs)	Program Chemist CH2M	Anita Dodson	(757) 671-6218	CAs for field and analytical issues will be determined by the Field Team Leader and/or the Project Chemist and reported to the PM within 4 hours. If serious laboratory issues are discovered, the Navy will be notified.
				Tracks data from sample collection through database upload daily.
Data tracking from field collection to database upload Release of analytical data	Project Chemist CH2M	Mark Cichy	(530) 229-3274	No analytical data can be released until validation of the data is completed and has been approved by the Project Chemist. The Project Chemist will review analytical results within 7 days of receipt for release to the project team. The Project Chemist will inform the CLEAN Program Chemist who will notify the Navy QAO of any laboratory issues that would prevent the project from meeting project quality objectives or would cause significant delay in project schedule.

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure (timing, pathway to and from, etc.)	
Reporting data quality issues	Data Validation PM TBD	TBD	TBD	The data validator reviews and qualifies analytical data as necessary. The data along with a validation narrative are returned to the Project Chemist within 14 calendar days.	
Field CAs	CH2M Field Team Leader	Kevin Smallwood	(970) 250-5441	Field and analytical issues requiring CA will be determined by the Field Team Leader and/or PM on an as-needed basis; the PM will ensure Quality Assurance Project Plan requirements are met by field staff for the duration of the project. The Field Team Leader will notify the PM via phone of any need for C	
	CH2M PM	Kim Henderson	(619) 272-7209	within 4 hours. The PM may notify the LRPM of any field issues that would negatively affect schedule or the ability to meet project data quality objectives (DQOs).	
Changes in the field	Utility Locater Driller		TBD	Documentation of deviations from planned field	
	Direct-push				
	Technology				
	Provider	TBD		procedures during project work will discussed with PM prior to implementation. Deviations will only be made with approval from the PM.	
	Surveyor				
	Investigation- derived waste				
	Transportation and Disposal Provider				

# SAP Worksheet #7—Personnel Responsibilities and Qualifications

Name	Title/Role	Organizational Affiliation	Responsibilities	
Danielle Janda	Navy LRPM	Navy BRAC	Oversees Project.	
George (Patrick) Brooks	Navy Project Supervisor	Navy BRAC	Oversees Project.	
Zachary Edwards	EPM, Health Physicist	NAVSEA RASO	Provides radiological technical support for the Navy.	
Matthew Slack	EPM, Health Physicist	NAVSEA RASO	Provides radiological technical support for the Navy.	
Matt Liscio	EPM, Health Physicist	NAVSEA RASO	Provides radiological technical support for the Navy.	
Lily Lee	USEPA RPM	USEPA	USEPA POC.	
Nina Bacey	RPM	DTSC	DTSC POC.	
Janet Naito	Branch Manager, Cleanup	DTSC	DTSC POC.	
Sheetal Singh	Environmental Management Branch	CDPH	CDPH POC	
Matt Wright	Environmental Management Branch	CDPH	CDPH POC	
Tina Low	RPM/Technical Staff Lead	Water Board	Water Board POC.	
Amy Brownell	Staff Lead Technical SFDPH	SFDPH	SDPH POC.	
Kim Henderson	PM	CH2M	Oversees project activities.	
Doug Dronfield	Deputy Program Manager	CH2M	Oversees program.	
Scott Hay	Radiological Lead	Cabrera	Provides subject matter support for project approach and execution.	
John Hackett	Radiological Lead	СН2М	Provides subject matter support for project approach and execution.	
Loren Kaehn	Health and Safety Manager	CH2M	Provides subject matter support for project approach and execution.	
Anita Dodson	Program Chemist	CH2M	Provides Uniform Federal Policy (UFP)-SAP project delivery support, reviews and approves UFP-SAPs, and performs final data evaluation and QA oversight.	
Janna Staszak	UFP-SAP Reviewer	CH2M	Reviews and approves changes or revisions to the UFP-SAP.	

# SAP Worksheet #7—Personnel Responsibilities and Qualifications (continued)

Name	Title/Role	Organizational Affiliation	Responsibilities
Mark Cichy	Project Chemist	СН2М	Data management: Performs data evaluation and QA oversight, is the POC with laboratory and validator for analytical issues.
Kevin Smallwood	Field Team Leader	CH2M	Coordinates all field activities and sampling.
TBD	Field Staff	CH2M, Perma-Fix	Conducts field activities.
Valerie Davis	Analytical Laboratory PM	GEL	Manages samples tracking and maintains good communication with Project Chemist.
Bob Pullano	Laboratory QAO	GEL	Responsible for audits, CA, and checks of QA performance within the laboratory.
TBD	Analytical Data Validation PM	TBD	Validate laboratory data from an analytical standpoint prior to data use.

## SAP Worksheet #8—Special Personnel Training Requirements

Project Function	Specialized Training by Title or Description of Course	Training Provider	Training Date	Personnel/ Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Radiological	General Employee Radiological Training	See Appendix B of the Parcel G Work Plan (Navy, 2018b)	Prior to initiation of fieldwork	All workers	All workers	Project File
	Radiological Worker Training and Certification	See Appendix B of the Parcel G Work Plan (Navy, 2018b)	Prior to initiation of fieldwork	All workers performing radiological work	Radiation Control Technician	Project File
	Radiological Control Technician Training and Certification	U.S. Department of Energy core, North East Utility Exam, National registry of Radiation Protection Technologists, etc. (Appendix B of Parcel G Work Plan [Navy, 2018b])	Prior to initiation of fieldwork	All workers performing radiological work	Radiation Control Technician	Project File

#### Notes:

In addition to health and safety-related training, other training may be required as necessary as outlined in the APP/SSHP.

# SAP Worksheet #9—Project Scoping Session Participants Sheet

Project Name:	Quality Assura	Analysis Plan (Fie nce Project Plan I Confirmation Si ipyard	Site Name: HPNS						
Projected Date(s) of Sampling: 2018-2019  Site Location: San Francisco, California									
Project Manager: Kim Henderson (619) 272-7209									
Date of Session: December 7, 2016									
Scoping Session Purpose:			liscuss radiological nput, and buy-in fro		nation and community	outreach			
Name	Title	Affiliation	Phone #	E-	mail Address	Project Role			
Danielle Janda	LRPM	Navy BRAC	(619) 524-6041	danielle	.janda@navy.mil	LRPM			
Derek Robinson	BEC	Navy BRAC	(619) 524-6026	derek.rc	binson@navy.mil	BEC			
Pat Brooks	BLTL/PM	Navy BRAC	(619) 524-5724	george.l	orooks@navy.mil	PM and BLTL			
Bill Franklin	Public Affairs Officer	Navy BRAC	(619) 524-5433	william.	d.franklin@navy.mil	Com Inv Lead			
Lily Lee	RPM	USEPA	(415) 947-4187	lee.lily@	epa.gov	Staff Lead Technical USEPA			
Jackie Lane	Com Inv Coordinator	USEPA	(415) 972-3236	lane.jacl	kie@epa.gov	Staff Lead Com Inv USEPA			
David Yogi	Manager, Com Inv	USEPA	(415) 972-3350	yogi.dav	rid@epa.gov	Mid Manager Com Inv USEPA			
Tamsen Drew	Senior PM/OCII Staff Lead	OCII (San Francisco)	(415) 749-2539	tamsen.	drew@sfgov.org	Senior PM/OCII Staff Lead			
Amy Brownell	Engineer	SFDPH	(415) 252-3967	amy.bro	wnell@sfdph.org	Staff Lead Technical SFDPH			
Scott Hay	Principal Health Physicist	Cabrera Services	(410) 332-8177	shay@c	abreraservices.com	Principal Health Physicist			
Janet Naito	Branch Manager, Cleanup	DTSC	(510) 540-3833	janet.na	ito@dtsc.ca.gov	Mid Manager Technical DTSC			
Nina Bacey	RPM	DTSC	(510) 540-2480	juanita.l	pacey@dtsc.ca.gov	Staff Lead Technical DTSC			
Sheetal Singh	Mid Manager CDPH	CDPH Environment al Health Branch	(916) 449-5691	sheetal.	singh@cdph.ca.gov	Mid Manager CDPH			

### SAP Worksheet #9—Project Scoping Session Participants Sheet (continued)

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Robert Kirkbright	Program Manager	CH2M	(619) 687- 0120 x37276	robert.kirkbright@ch2m.co m	Program Manager
Jeff Wong		CDPH Radiological Health Branch		jeff.wong@cdph.ca.gov	
Tina Low	RPM	Water Board	(510) 622- 5682	tina.low@waterboards.ca.g ov	Staff Lead Technical Water Board
Kellie Koenig	Vice President	CH2M	(619) 272- 7217	kellie.koenig@ch2m.com	Vice President
Adam Engel	Health Physicist	CH2M	(619) 272- 7286	adam.engel@ch2m.com	Data Reviewer
LCDR Soric		NAVSEA RASO			
Lindsey Land					
Matthew Slack	Environmental PM	NAVSEA RASO	(757) 887- 4212	matthew.slack@navy.mil	Technical Expert Navy
Dr. Stephen Doremus	Director	NAVSEA RASO	(757) 887- 4692	steve.doremus@navy.mil	Technical Expert Navy
Zachary Edwards	Manager, Health Physicist	NAVSEA RASO	(757) 887- 7762	zachary.edwards@navy.mil	Technical Expert Navy
Jana Dawson	Health Physicist (Techlaw Contractor)	USEPA		jdawson@techlawinc.com	Technical Expert USEPA
Karla Brasaemle	Geologist (Techlaw Contractor)	USEPA		kbrasaemle@techlawinc.co m	Technical Expert USEPA
Mark Luckhardt		Five Point			

#### **Comments/Decisions:**

A detailed summary of the meeting is included in **Attachment 1**.

#### **Action Items:**

- Determine whether pre-2006 data were used for decision making.
- Provide library of compiled questions and answers on community outreach to share with team.
- Plan twice a month Community Outreach Team check-in meeting.
- E-mail copy of Draft Radiological Community Engagement Plan/Communications Plan to RASO.

SAP Worksheet #9—Project Scoping Session Participants Sheet (continued)

#### **Consensus Decisions:**

- USEPA, DTSC, and the project team agreed that if the pre-2006 data were superseded by other work done after 2006, the pre-2006 data do not need to be analyzed.
- Statistical tests will identify anomalies in the data, including running tests designed to identify
  instances where data may have been falsified. It was agreed that areas of highest potential risk
  should be the priority.

#### Follow Up:

The Navy assembled a Technical Team (a group of technical experts) that includes representatives from the Navy, USEPA, DTSC, CDPH, and the City of San Francisco. The Technical Team conducted an evaluation of previous HPNS data in light of the claims made and is developing an approach for follow up investigations. The Technical Team has met weekly beginning in 2017 to discuss project updates and review documents. As an outcome of the meetings and review of previously submitted iterations of the work plan, it was determined that the investigation approach for collection and evaluation of data will be based on the Parcel G ROD (Navy, 2009) and the Basewide Radiological Management Plan (TtEC, 2012). For soil, the work plan details a phased approach that was designed based on a proposal by the regulatory agencies on an initial draft work plan. Similarly, for buildings, the work plan details an approach that was designed based on regulatory comments on an initial draft work plan. The investigation approaches for soil and buildings are included in the Draft Parcel G Removal Site Evaluation Work Plan, herein referred to as the Parcel G Work Plan (Navy, 2018b), which has been submitted and is currently in review. The investigation approach reflected in the work plan is carried into this SAP.

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### SAP Worksheet #10—Conceptual Site Model

This section provides an updated conceptual site model (CSM) (Table 10-1). The CSM summarizes the site description, history, and current status related to radiologically impacted buildings and former building areas, and former sanitary sewers and storm drains identified in the Historical Radiological Assessment (HRA) (NAVSEA, 2004). The sanitary sewers and storm drains were once a combined system identified as radiologically impacted because of the possibility that radioactive waste materials had been disposed of in sinks and drains, and the potential for the surrounding soil to be impacted by leakage and soil mixing during repairs. A removal action was initiated in 2006 to remove the sanitary sewers and storm drains. The removal action included excavation of overburden soil, removal of pipelines, plugging of open sanitary sewers and storm drains left in place during the removal process, ex situ radiological screening and sampling of the pipeline, and performance of final status surveys of the excavated soil and exposed excavation of trench surfaces. Soil was removed to a minimum of 1 foot below and to the sides of the sanitary sewer and storm drain piping.

Following the investigation and removal actions, there were allegations that TtEC potentially manipulated and falsely represented data. In addition, the onsite laboratory used a screening method to analyze radium-226 (226Ra) that may have reported at levels higher than actual radioactivity. TtEC presented CSMs in RACRs that were based on potentially falsified data and screening results for 226Ra reported by the onsite laboratory (results were often biased high). As a result, the Navy will conduct investigations at radiologically impacted soil and building sites in Parcel G that were surveyed by TtEC. The results of additional investigation activities presented in this SAP and the Parcel G Work Plan (Navy, 2018b) will be used to update the CSM as needed.

Analytical results for <sup>226</sup>Ra were reported by the onsite laboratory using a screening method based on the 186 kiloelectron volt (keV) energy peak. The offsite laboratory analyzed <sup>226</sup>Ra using a definitive method (USEPA 901.1 comparable method), allowing the soil samples to equilibrate (21-day in-growth) and reported concentrations using the 609 keV energy peak for bismuth-214 (<sup>214</sup>Bi) because <sup>214</sup>Bi is in secular equilibrium with <sup>226</sup>Ra. Comparisons between the onsite laboratory screening results and the offsite laboratory definitive results for <sup>226</sup>Ra demonstrate the onsite laboratory results were consistently biased high. The <sup>226</sup>Ra analytical results from the onsite laboratory resulted in false exceedances of the remediation goals (RGs), which resulted in the initiation of remediation. Remediation may have been avoided had soil samples been allowed to equilibrate (21-day in-growth) and decisions had been based on the more reliable <sup>214</sup>Bi analysis using the 609 keV energy peak.

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## SAP Worksheet #10—Conceptual Site Model (continued)

Table 10-1. Cond	eptual Site Model	
	Site Name	Former Hunters Point Naval Shipyard (Parcel G)
Site Location Site Operations and History		Located on San Francisco Bay near the southeastern boundary of San Francisco, California. HPNS encompasses approximately 848 acres, including approximately 416 acres on land, at the point of a high, rocky, 2-mile-long peninsula projecting southeastward into San Francisco Bay. Parcel G occupies 40 acres in the middle of HPNS ( <b>Figure 10-1</b> ).
		<ul> <li>NRDL activities associated with analyzing samples from nuclear weapons tests, scientific studies (fallout, plant, animal, materials), and production and use of calibration sources.</li> <li>Use of radiography sources.</li> <li>Use and potential disposal of radiological commodities, including discrete devices removed from ships (deck markers, radium dials) and welding rods.</li> <li>Historical radiological material use documented in HRA (NAVSEA, 2004). Lists "impacted sites" – sites with potential for radioactive contamination.</li> <li>Former surface soil impacted by fallout may be subsurface soil today because of fill activities.</li> </ul>
Histori	cal Site Conditions	Facility created from fill with some background levels of radionuclides (e.g., NORM and fallout). Dredge spoils from local berths were used as fill for some areas. Trenches were backfilled following removal of sewer lines. Trench backfill is mixed, but documentation of source is available (onsite fill, offsite fill, or mixture). Bay mud or bedrock marks bottom extent of fill material.  Site drainage system was designed in the 1940s to discharge to San Francisco Bay and was separated into sanitary sewers and storm drains in 1958, 1973, and 1976, but never completed.
Potential Source Areas	Potential Historical Sources of Radiological Contamination	<ul> <li>Potential spills and releases from the following:         <ul> <li>Storage of samples from nuclear weapons tests at various NRDL facilities</li> <li>NRDL waste disposal operations:                 <ul></ul></li></ul></li></ul>
Source Areas	Release Areas in Parcel G	Known Release Areas (from Page 6-38 of HRA):  Building 351A:  Contaminated sinks and drain lines in Room 47 were removed  Buildings 317/364/365 Site:  "Peanut Spill" (small peanut-shaped spill adjacent to Building 364)  Liquid waste tanks removed  Contamination identified in yard and removed  Contaminated sinks and drain lines connected to the liquid waste tanks, not to the sanitary sewer, were removed Potential Releases Identified after the HRA:  Building 366 ventilation and potential releases to soil.

### SAP Worksheet #10—Conceptual Site Model (continued)

#### Table 10-1. Conceptual Site Model

**Potential** 

Source Areas

Impacted Buildings in

Parcel G

#### Impacted Buildings with High Contamination Potential (from Table 8-2 of HRA):

• Building 364 (demolished) - Previously a concrete structure, measuring approximately 40 feet by 50 feet, used as an animal irradiation and research facility, for isotope processing and decontamination studies, and as a general research laboratory. Building 364 also contained a hot cell used to perform some of these processes. A liquid radioactive waste collection area was previously located at the rear of the building. Following closure of HPNS, it was leased to a laboratory company, which performed assay operations and has since been demolished.

#### Impacted Buildings with Moderate Contamination Potential (from Table 8-2 of HRA):

- Building 351 Vacant three-story reinforced-concrete shop building with a five-story tower at the northwestern
  corner, covering approximately 35,166 square feet of floor space. Building 351 was previously used as an electronics
  work area/shop, optical laboratories, Navy Bureau of Medicine and Surgery storeroom, machine shop (first floor),
  sampling laboratory, general research laboratories, and biological research laboratories. The NRDL also used the
  building as materials and accounts division, technical information division, office services branch, thermal branch,
  engineering division, and library.
- Building 351A Vacant one-story concrete building, covering approximately 35,166 square feet of floor space, constructed in 1952 over a crawl space that abuts the southern end of the building. Building 351A was used as a radiation detection, indication and computation repair facility and electronics shop for radiation detection equipment and a facility for the calibration, repair, and reconditioning of other instruments. The NRDL also used the building as a chemistry laboratory, applied research branch, administrative offices, nuclear and physical chemistry laboratory, and chemical technology division.
- Building 366 Vacant, one-story, raised-ceiling structure composed of an exterior "sheet metal" shell with interior room constructed of traditional wood and sheetrock materials, measuring approximately 280 feet by 130 feet. The building was built over a full-floor concrete pad with isolated areas of asphalt patching. Building 366 was used as administrative offices, applied research and technical development branches, radiological safety branch, management planning division, nucleonics division, instruments evaluation section, general laboratories, chemical research laboratory, shipyard radiography shop, boat/plastic shop, and other military/navy branch project officers station. NRDL also used the building for instrument calibration and management engineering and comptroller department.
- Building 408 (demolished) Previously a steel-framed structure enclosing two free-standing furnaces, used for smelting, that were constructed in 1947. The building was the equivalent of three stories at its northern end, dropping to one story at its southern end, and open-sided on the north. A firebrick-lined hearth occupied most of the open area at the north. Natural gas burners were present on the eastern and western sides of the hearth, and a pair of smokestacks extended from the lower rear segment of the building. The building has been demolished, and the concrete building pad is all that remains.

#### Impacted Buildings with Low or No Contamination Potential (from Table 8-2 of HRA):

- Building 317 (demolished) Previously a concrete structure measuring approximately 30 feet by 40 feet, used by NRDL personnel for temporary animal quarters.
- Building 365 (demolished) Previously a wooden structure with a concrete foundation that measured approximately 30 feet by 40 feet. Building 365 was used as a personnel decontamination facility, change house, and storage building.
   The NRDL also used the building as a small animal facility.
- Building 411 Vacant curtain-walled, steel-framed building with a flat roof and includes a saw-toothed series of rooftop monitors as well as bands of steel industrial sash and large glazed industrial doors, measuring approximately 185,000 square feet. Building 411 was used for source storage, as a civilian cafeteria, shipfitters and boilermakers shop, and ship repair shop. A leading enclosure measuring approximately 25 feet by 15 feet was in the building and housed an x-ray machine used for radiography.

### Buildings Identified after the HRA:

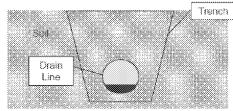
- Building 401 Vacant two-story building measuring approximately 100 feet by 250 feet. Building 401 was previously used as a supply storehouse, trades shop, and general stores, and by public works as a maintenance shop and offices. In 2005, the civilian tenant had been made aware of the presence of gauges and dials containing <sup>226</sup>Ra and provided the gauges and dials to the Navy.
- Building 439 Vacant one-story building measuring approximately 250 feet by 400 feet. Building 439 was previously used by the Navy as an equipment storage facility. Following closure of HPNS, the building was leased by a skateboard company for use as a manufacturing and assembly plant. In 2002, Young Laboratories, a civilian tenant, was relocated to a 40-foot by 50-foot enclosed area in the northwestern corner of the building with a separate outside entrance. Young Laboratories processed and analyzed metals and other materials containing metals as part of its assay operations. Previous investigations in Building 364 identified an old kiln that was assumed to have been used by Young Laboratories and a subsequent survey identified slag material inside containing <sup>226</sup>Ra. Additional surveys within Building 364 identified areas of elevated <sup>137</sup>Cs activity. The Navy identified Building 439 as potentially impacted based on potential cross-contamination from Building 364 during relocation.

#### Radionuclides of Concern for Parcel G (from Table 8-2 of HRA)

- <sup>226</sup>Ra
   <sup>137</sup>Cs
- 90Sr
- <sup>60</sup>Co (only for interior surfaces of former Buildings 364 and 365 and Building 411)
- <sup>232</sup>Th (only building interior surfaces)
- 235U (only for interior surfaces of former Building 365)
- <sup>239</sup>Pu (only for interior surfaces of Building 351A and former Buildings 364 and 365)

### Releases to soil and air.

- Releases to sanitary sewer lines.
  - Buildings with known releases
- Releases to storm drains.
  - Incomplete separation from sanitary sewer lines
  - Runoff from surface spills.
  - Releases from potentially leaking storm drain and sanitary sewer lines to surrounding soil (now removed).
  - Release of sediments from breaks or seams during pressure washing of drain lines.



Conceptual Cross Section of Drain Lines

## Potential Migration Pathways

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### SAP Worksheet #10—Conceptual Site Model (continued)

Table 3	10-1.	Conceptual	Site	Model
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### Soil: External radiation from ROCs Incidental ingestion and inhalation of soil and dust with ROCs for intrusive activities disturbing soil beneath the **Potential Exposure Pathways** durable cover (only construction worker receptor) Building surfaces: External radiation from ROCs Inhalation and incidental ingestion of resuspended radionuclides HPNS is not an active military installation. In 1991, HPNS was selected for closure pursuant to the terms of the Defense BRAC Act of 1990. For more than 20 years, the Navy leased many HPNS buildings to private tenants and Navy-related entities for industrial and artistic uses. Current leases include art studios and a police department facility. Parcels A, D-2, and UC-1 have been transferred to the City and County of San Francisco for nondefense use, and the remaining areas of HPNS are also planned to be transferred. All known sources of radiological material removed by Navy using standards at the time. **Current Status** Follow-up investigations resulted in removal of small volumes of soil to meet current RGs. Sanitary sewer and storm drain removal investigation conducted at Parcel G from 2007 to 2011. More than 4 miles of trench lines and 50,000 cubic yards of soil investigated and disposed of or cleared for use as onsite fill. Trench excavations that have been backfilled now contain homogenized soil from onsite fill, offsite fill, or a mixture Lower potential for radiological contamination than originally described in historical CSMs based on the following lines of evidence:

## Uncertainties

- Known sources have been removed.
- Sanitary sewers and storm drains periodically power washed before 2000.
- Sanitary sewers and storm drains, and 1 foot of soil surrounding the pipe removed. The sewer lines were removed to within 10 feet of all buildings. Impacted buildings had remaining lines removed during surveys of the buildings. Non-impacted buildings had surveys performed at ends of pipes, and pipes were capped.
- Any residual concentrations may be modified by radiological decay (shorter-lived radionuclides, such as <sup>137</sup>Cs and <sup>90</sup>Sr) or remobilization (including weathering and migration).
- Sediment data from inside pipe not indicative of a large quantity disposal or contamination (maximum <sup>226</sup>Ra concentration of 4.2369 pCi/g and maximum <sup>137</sup>Cs concentration of 0.87795 pCi/g in Parcel G).
- Overestimate of <sup>226</sup>Ra concentrations in soil by the onsite laboratory using an imprecise measurement method.
- LLRW bins were tested by the Navy's independent waste broker at an offsite laboratory using 5-point composites, and only 3 out of 1,411 bins had results with <sup>226</sup>Ra above the RGs.
- Potential for data manipulation or falsification.
- Data quality deficiencies.
- 137Cs and 90Sr are present at HPNS because of global fallout from nuclear testing or accidents, in addition to Navy activities. Because of backfill activities, <sup>137</sup>Cs and <sup>90</sup>Sr from fallout and Navy activities are not necessarily only on the surface and may be present in both surface and subsurface soil.
- Potential for isolated radiological commodities randomly distributed around the site.
- Trenches where scan data exceeded the investigation level and biased soil samples were not collected.

### Notes:

 $^{60}$ Co = cobalt-60

90Sr = strontium-90

 $^{137}$ Cs = cesium-137

 $^{232}$ Th = thorium-232

 $^{235}U = uranium-235$ 

<sup>239</sup>Pu = plutonium-239

LLRW = low-level radioactive waste

NORM = naturally occurring radioactive material

NRDL = Naval Radiological Defense Laboratory

pCi/g = picocurie(s) per gram

RG = remediation goal

ROC = radionuclide of concern

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## SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
State the Problem	Identify the Objective	Identify Inputs to the Objective	Define the Study Boundaries	Develop Decision Rules	Specify the Performance Criteria	Develop the Plan for Obtaining Data
There have been various allegations of data manipulation or falsification committed by a contractor during past sanitary sewer and storm drain removal actions and current and previous soil and building investigations in Parcel G. The Technical Team evaluated soil and building survey data and found evidence of potential manipulation and falsification. The findings call into question the reliability of soil and building data, and there is uncertainty whether radiological contamination was present or remains in place. Therefore, the property is unable to be transferred as planned. Based on the uncertainty and the description of radiological activities in the HRA, there is a potential for residual radioactivity to be present in soil and on building interior surfaces. Furthermore, HPNS was expanded over time using fill materials with a range of NORM concentrations. Construction and remediation projects over the past 60 years have disturbed the surface soil, making a determination of background concentrations for ubiquitous anthropogenic radionuclides from fallout difficult. Previous HPNS soil background values did not provide <sup>226</sup> Ra concentrations representative of all fill materials found at HPNS and did not include other NORM or fallout radionuclides.	The primary objectives of the study are as follows:  To determine whether site conditions in soil and building surfaces are compliant with the Parcel G ROD remedial action objective (RAO) (Navy, 2009).  To establish representative background data sets for soil ROCs, NORM radionuclides, and fallout ROCs for comparison and evaluation of soil data collected from HPNS.	The inputs for each component of the study are as follows:  Soil Investigation:  Surface soil and subsurface soil analytical data for ROCs provided by an accredited offsite laboratory. The ROCs for the soil investigation are listed below and are presented in Worksheet #17.  ROCs for the soil areas are 137Cs, 226Ra, 90Sr, and 239Pu  Gamma scan survey measurements to identify biased soil sample locations.  Reference Background Area (RBA) Investigation:  Soil analytical data for ROCs, NORM radionuclides, and fallout radionuclides provided by an accredited offsite laboratory. All RBA samples will be analyzed by the respective method for the radionuclides listed in Worksheets #15a, #15b, #15c, and #15d.  Gamma scan survey measurements of accessible surface soil, including gross gamma and in situ gamma spectroscopy, to support selection of appropriate gamma scan instrumentation based on a priori detectability.  Building Investigation:  Alpha-beta static, scan, and swipe data collected by radiological survey instruments on buildings and reference area surfaces	The study boundaries for each component of the study are as follows:  Soil Investigation:  Phases 1 and 2 trench units (TUs) and survey units (SUs) listed in Worksheet #17 and shown on Figure 11-1.  Soil Background Characterization:  RBAs at HPNS in Parcels B, C, D-1, D-2 (Figure 11-2), and an undisturbed off-base location (Figure 11-3) will provide a range of background estimates.  Building Investigation:  Accessible interior surfaces of Buildings 351, 351A, 366, 401, 411, and 439, and the concrete pad at former Building 408 (Figure 11-4). The building floor SUs are depicted on Figures 11-5 through 11-11.	<ul> <li>If the building and soil investigation results demonstrate that site conditions are compliant with the Parcel G RAO, then a remedial action completion report (RACR) will be developed. The RACR will describe the results of the investigation and will provide a demonstration that radioactivity levels meet the Parcel G RAO or represent background conditions.</li> <li>If the building and soil investigation results demonstrate that site conditions are not compliant with the Parcel G RAO and exceed background levels, then the data will be evaluated to determine whether site conditions are protective of human health using USEPA's current guidance on Radiation Risk Assessment at CERCLA Sites (USEPA, 2014a). A Removal Site Evaluation Report will be developed to include recommendations for further action.</li> <li>RBA data sets will be compared and evaluated to provide representative RBA data sets with a description to assist in determining applicability for specific projects at HPNS. The data evaluation process is summarized below and detailed in Parcel G Work Plan (Navy, 2018b):         <ul> <li>Identify outliers graphically or statistically using Dixon and Rosner's tests for outliers by comparing the calculated Q values or R values to the critical value, corresponding to a confidence level of 95 percent.</li> </ul> </li> </ul>	The performance criteria for each component of the study are as follows:  • The soil investigation data evaluation process for demonstrating compliance with the Parcel G ROD RAO is summarized below and depicted on Figure 11-12:  - Analysis will be based on the site-specific ROCs (Worksheet #17). All soil samples at a minimum will be assayed by gamma spectroscopy for 137Cs and 226Ra with at least 10 percent of samples receiving gas flow proportional analysis for 90Sr. Additionally, if the laboratory results indicate concentrations of 137Cs above its RG (Worksheet #15a), the sample will be analyzed for 90Sr. If the laboratory results indicate the presence of concentrations of 137Cs or 90Sr at or above the respective RG (Worksheets #15a and #15c), additional analysis via alpha spectroscopy for 239Pu will be performed (Worksheet #15b). Gamma spectroscopy data will be reported by the laboratory after a full 21-day in-growth period. If the results following the full in-growth are below the RGs shown in Worksheets #15a and #15c, additional analyses are not required.  - For samples with 226Ra results at or above the RG (Worksheet #15a), additional analyses are required to complete a NORM evaluation as described in the Parcel G	Data for each component of the study will be obtained through the following methods:  Soil Investigation:  Phase 1 TUs/SUs — The radiological investigation will be conducted on a targeted group of 21 of the 63 TUs associated with former sanitary sewers and storm drains, and 14 of the 28 SUs associated with surface soil at building sites in Parcel G (see Figure 11-1). The Phase 1 TUs/SUs will be investigated using gamma scan surveys and soil sampling as described in Worksheets #14 and #17.  Phase 2 TUs/SUs — Additional soil sampling will be conducted on the remaining 42 TUs and 14 SUs in Parcel G (see Figure 11-1). The Phase 2 TUs/SUs will be investigated with soil sampling and scanning of soil cores as described in Worksheets #14 and #17.  The soil samples collected as part of the Phase 1 and Phase 2 investigations will be analyzed for the applicable ROCs by accredited offsite laboratories and the results will be evaluated as described in Step 6. Global positioning system (GPS) location correlated results will be collected or surveying conducted to facilitate relocation if further investigation is warranted.  Soil RBA Investigation:  RBAs will be investigated using gamma scan surveys of 100 percent of surface soil and systematic surface and subsurface soil samples as described in Worksheets #14 and #17.  Soil samples will be analyzed for the applicable ROCs along with NORM radionuclides and fallout radionuclides by accredited offsite laboratories (Worksheet #17).  Building investigations  Building investigations will be conducted on floors, wall surfaces, and ceiling surfaces, and will consist of alpha and beta scan surveys, alpha-beta static measurements, and alpha-beta swipe samples as described in Worksheets #14 and #17.

# SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
State the Problem	Identify the Objective	ldentify Inputs to the Objective	Define the Study Boundaries	Develop Decision Rules	Specify the Performance Criteria	Develop the Plan for Obtaining Data
		- Radioactivity concentration data for material samples provided by an accredited offsite laboratory (if needed)		If outliers are identified graphically or statistically (Q value or R value is greater than critical value), the outlier will be investigated to attempt to determine whether the outlier is the result of contamination, data quality issues, an environmental issue (e.g., different soil type), or an unidentified issue.  If no outliers are identified, the entire data set will be used in its entirety.  Determine statistical difference between data sets using the non-parametric Kruskal-Wallis (KW) test by comparing the calculated p-value against 0.05 significance level.  If the results of the KW test indicate that two or more data sets are statistically similar (p-value is greater than significance level), those data sets may be combined to form a larger data set representing more of HPNS, such as a larger area, multiple soil depths, or additional soil types.  If the results of the KW test indicate that a data set is statistically different from other data sets (p-value is less than significance level), that data set will not be combined with other data sets and will be representative of a specific area, soil depth, or soil type.	Work Plan (Navy, 2018b). Analyses using alpha spectroscopy for uranium-238 (238U) along with an analytical method for 226Ra comparable with alpha spectroscopy for 238U (e.g., radon emanation) will be performed (Worksheets #15b and #15d). For that specific sample, the 238U alpha spectroscopy result will be used as a more representative estimate of the background value for 226Ra, and the alpha spectroscopy comparable results for 226Ra will be compared to the RG for 226Ra using the revised background value.  • All RBA samples will be analyzed by the respective method for the radionuclides listed in Worksheets #15a, #15b, #15c, and #15d. A statistical data evaluation will be conducted to identify appropriate soil background data sets and calculate descriptive statistics to facilitate future comparisons with site-specific data. The purposes of the data evaluation are as follows:  — Identify outliers using Dixon and Rosner's tests for outliers.  — Determine statistical differences between soil groups using the KW test.  — Compare soil data sets from surface gamma scan surveys, and surface and subsurface analytical concentrations against different identified soil types and against each RBA per sample depth.	

## SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
State the Problem	Identify the Objective	Identify Inputs to the Objective	Define the Study Boundaries	Develop Decision Rules	Specify the Performance Criteria	Develop the Plan for Obtaining Data
					<ul> <li>Establish one or more representative reference area data sets.</li> <li>The building investigation data evaluation process for demonstrating compliance with the Parcel G ROD is presented as follows and</li> </ul>	
					depicted on <b>Figure 11-13</b> :  - Compare each net alpha and net beta result to the corresponding RG from <b>Worksheet #17</b> :	
					If all results are less than or equal to the RGs, then compliance with the ROD RAO is achieved and a RACR will be prepared.	
					If any result is greater than the RG, then a Removal Site Evaluation Report will be prepared	

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## SAP Worksheet #12—Field Quality Control Samples – Soil Measurement Performance Criteria Table – Field QC Samples

QC Sample	Analytical Group	Frequency	Data Quality Indicators	Measurement Performance Criteria
Field Duplicate	Radiological (alpha and gamma spectroscopy, Gas Flow Proportional Counting [GFPC],	One per every 10 field samples collected	Precision	Relative percent difference (RPD) < 25 percent
Equipment Blank				No target analytes detected > minimum detectable concentration (MDC)
Field Blank		One per source water per sampling event	Bias/Contamination	No target analytes detected > MDC
Split Sample <sup>a</sup>		To be determined by the stakeholders on a case by case basis for each site	N/A	None

May be collected if requested by other stakeholders (USEPA or CDPH) and will be evaluated by the stakeholder. Measurement and performance criteria will be outlined in the stakeholder guidance documents.

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## SAP Worksheet #13—Secondary Data Criteria and Limitations

Secondary Data	Data Source (originating organization, report title, and date)	Data Generators (originating organization, data types, data generation/collection dates)	How Data Will be Used	Limitation on Data Use
Remediation Goals	Department of the Navy Basewide Radiological Removal Action, Action Memorandum— Revision 2006 April 2006	Navy, RGs for soil and surfaces	To determine whether site conditions in soil and building surfaces are compliant with the Parcel G ROD RAO (Navy, 2009), analytical and building data will be compared to the RGs for Parcel G ROCs.	The RGs will be applied as concentrations above background.
Trench Unit, Survey Unit Boundaries and Depths	TtEC  Multiple plans and reports and the Parcel G Remedial Action Completion Report  2010 - 2011	TtEC, site figures, building layouts, floor plans	Data will be used as the boundaries for TUs and SUs included in the Soil and Building Investigations.	Electronic versions of previous excavations and are not available. Alterations of building interiors may have taken place. Therefore, best management practices (BMPs) will be used to locate and mark the boundaries of former TUs and SUs.

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### SAP Worksheet #14—Summary of Project Tasks

This worksheet contains procedures for field activities as a supplement to the Parcel G Removal Site Evaluation Work Plan (Navy, 2018b), which contains detailed information on the radiological support activities that will be conducted during the soil and building investigation activities outlined in this SAP. Field SOPs specific to the soil sampling and building investigation discussed in this SAP are presented in **Worksheet #21**. All radiological support work will be performed in accordance with the radiological SOPs, which are included as Appendix B of the Parcel G Work Plan (Navy, 2018b).

### Premobilization Activities

Before initiating field investigations, several premobilization steps will be completed to ensure that the work can be conducted in a safe and efficient manner. The primary premobilization tasks include procurement of subcontractor services, training of field personnel, permitting and notification, a pre-construction meeting, offsite RBA access, and building walkthroughs, as described below.

#### **Procurement of Subcontractor Services**

A list of the various support services that are anticipated to be required are as follows:

- Radiological analytical laboratory services
- Drilling subcontractor
- Civil surveying subcontractor
- Utility location subcontractor
- Vegetation clearance subcontractor
- Transport (trucking) subcontractor
- Concrete coring subcontractor

#### **Permitting and Notification**

Before initiation of field activities for the radiological investigation, the contractor will notify the Navy RPM, Resident Officer in Charge of Construction (ROICC), RASO, and HPNS security as to the nature of the anticipated work. Any required permits to conduct the fieldwork will be obtained before mobilization.

The contractor will notify the California Department of Public Health at least 14 days before initiation of activities involving the Radioactive Material License.

#### **Pre-Construction Meeting**

A pre-construction meeting will be held before mobilization of equipment and personnel. The purpose of the meeting will be to discuss project-specific topics, roles, and responsibilities of project personnel, project schedule, health and safety concerns, and other topics that require discussions before field mobilization. Representatives of the following will attend the pre-construction meeting:

- Navy (RPM, RASO, ROICC, and others as applicable)
- Contractor (PM, Site Construction Manager, Project QC Manager, RSO, and SSHO)
- Subcontractors as appropriate

#### Offsite Reference Background Area Access

Prior to initiation of the RBA investigation, coordination with the City of San Francisco will be conducted to facilitate access and approval for sampling and ground disturbance activities at Bayview Park. Sampling at Bayview Park will be conducted only if access and approval are granted.

### **Building Walkthroughs**

Prior to the start of building survey activities, a walk-through of Parcel G buildings will be completed to accomplish the following:

- Establish building access points and assess security requirements.
- Assess survey support needs such as power, lighting, ladders, or scaffolding.
- Verify the types of materials in each SU.
- Identify safety concerns and inaccessible or difficult-to-survey areas.
- Identify radiological protection and control requirements.
- Identify materials requiring removal or disposal, and areas requiring cleaning.
- Assess methods for marking survey scan lanes and static measurement locations.

Impacted areas that are deemed unsafe for access or surveying, such as the mezzanine of Building 411, will be posted, secured, and noted in reports.

#### Mobilization Activities

At least 2 weeks before mobilization, the appropriate Navy personnel, including the Navy RPM and ROICC and Caretaker Site Office, will be notified regarding the planned schedule for mobilization and site investigation activities. Upon receipt of the appropriate records and authorizations, field personnel, temporary facilities, and required construction materials will be mobilized to the site.

The applicable activity hazard analysis forms will be reviewed prior to starting work. The temporary facilities will include restrooms, hand-washing stations, and one or more secure storage (Conex) boxes for short- and long-term storage of materials, if needed.

The mobilization activities are summarized below and are described in detail in the Parcel G Work Plan (Navy, 2018b).

#### Soil Investigation

The mobilization activities for the soil investigation will include the following:

- Confirming soil TU and SU boundaries.
- Establishing a radiologically controlled area.
- Stormwater, sediment, and erosion control measures.
- Implementation of dust control methods and air monitoring.
- Underground Service Alert will be contacted at least 72 hours before initiating intrusive activities.
- Removal and survey of the durable cover of Phase 1 TUs.
- Movement of equipment and materials to the site. All equipment mobilized to the site will undergo baseline
  radioactivity surveys in accordance with the Parcel G Work Plan. Surveys will include directs scans, static
  measurements, and swipe samples. Equipment that fails baseline surveying will be removed from the site.

#### Reference Background Area Investigation

The mobilization activities for the RBAs will include the following:

- Vegetation clearance
- Utility location and clearance
- Surface debris removal
- Removal of the durable cover

Locate and mark the planned sample locations (Sample locations are detailed in Worksheet #17.)

#### **Building Investigation**

The mobilization activities for the building investigation will include the following:

- Removal of loose, residual debris or asbestos and lead abatement to prepare the buildings for cleaning
- Implementation of dust control methods and air monitoring
- Cleaning of floors, walls, and other surfaces
- Evaluation and disposal of waste generated from cleaning activities

### Investigation Activities

Once site preparation activities are completed, investigation activities will commence. The following sections describe the field activities specific to each component of the investigation. The survey design for each component is described in detail in the Parcel G Work Plan (Navy, 2018b) and summarized in **Worksheet #17**.

#### Soil Investigation

There are two types of Parcel G soil investigations, including surveys of the following:

- Surface and subsurface soil associated with former sanitary sewer and storm drain lines (TUs)
- Surface soil areas associated with soil from building sites (SUs)

A two-phased approach for the investigation of TUs/SUs is planned. The size and boundary of the TUs and SUs will be based on the previous plans and reports. Locating and marking the boundaries of the former TUs and SUs will be accomplished by using BMPs to identify boundaries and depths of the former TUs and SUs based on the previous TtEC reports (e.g., survey reports, drawings, and sketches), field observations (such as GPS locations from geo-referencing, borings, and visual inspection), and durable cover as-built records (**Worksheet #13**). Once the boundaries are located, the areas will be marked with paint or pin flags.

#### Phase 1 Trench Unit

Each Phase 1 TU (Worksheet #17) will be excavated to the original excavation limits and evaluated in approximately 152-cubic-meter (~200-cubic-yard) excavated soil units (ESUs). Once the excavation to the original excavation limits has been complete, over-excavation of at least an additional 6 inches outside the estimated previous boundaries of the sidewalls and bottom will be initiated. This exhumed over-excavated material will be maintained separately from the ESUs and will represent the trench sidewalls and floor (sidewall floor unit or SFU).

The excavated material will then undergo radiological assay following either the automated soil sorting process or Radiological Screening Yard (RSY) pad process as described in the following sections. One hundred percent of the Phase 1 ESU soils will undergo scan surveys using real-time gamma spectroscopy equipment in the soil sorting process or the RSY pad process. The over-excavated material (SFUs) will be investigated in the same fashion as the excavated soil (ESU) by gamma scan surveys and soil sample collection (soil sorting system process or RSY process). Following completion of investigation activities, the ESU and SFU material will be returned to the same trench from which the material originated.

The soil sorting system process, RSY pad process, and associated scanning instrumentation are described in further detail in the Parcel G Work Plan (Navy, 2018b). A summary of the sampling design and rationale associated with these processes is included in **Worksheet #17**.

#### **Automated Soil Sorting System**

Soil sorting systems are radiological monitoring and processing systems designed to perform real-time segregation of soil into two distinct bins based upon the soil's radiological properties. The material is sorted into two distinct bins (piles), commonly referred to as the "Below Criteria" and "Diverted Pile" bins. The basis upon which the soil material is sorted and segregated into distinct volumes is controlled by the establishment of "diversion control setpoints" that automatically trigger the diverting mechanism, sorting the material into the appropriate bin. The diversion control setpoints will be chosen as described in the Parcel G Work Plan (Navy, 2018b). Using typical earth moving equipment, such as a front-end loader or excavator, soil from the ESU or SFU will be fed to the soil sorting system. The material will move past the active area of the detectors, and the system's software will interpret the spectroscopy data to determine whether the volume of soil exceeds the specified alarm points. As the material continues to travel up the conveyor, it is automatically sorted in one of two bins. Eighteen systematic soil samples will be collected from each ESU and SFU during assay with the soil sorting system. Additionally, a minimum of one biased soil sample will be collected from the soil material that has been discharged to the "Diverted Pile" bin.

#### Radiological Screening Yard Pad

If a conveyor-based automatic soil sorting system process is not used, excavated TU material will be assayed using the RSY pad process. RSY pad processing has previously been used at HPNS as described in the Basewide Radiological Management Plan (TtEC, 2012). If no existing RSY pads are available for use, pads will be constructed to meet the requirements specified in the Basewide Radiological Management Plan (TtEC, 2012), RSY Construction Details (TtEC, 2009b), or other current Navy guidance. RSY pads will be constructed with a size limit of 1,000 square meters (m²). Before construction, the area where the RSY pads will be constructed will be radiological scan-surveyed to document the existing conditions.

Excavated TU materials will be transported to the RSY pad by dump truck or other conventional means and spread approximately 6 inches thick. Processing activities in the RSY pads include gamma scan surveys, systematic and biased soil sampling and analyses, follow-up investigation activities (as necessary), radiologically clearing the materials for reuse or disposal, and transport of the materials off the RSY pads.

#### Phase 2 Trench Unit

Each Phase 2 TU (Worksheet #17) will be investigated using a combination of soil core scan surveys and subsurface soil sample collection. Subsurface soil samples will be collected as described in Worksheet #21 and Attachment 2).

Six systematic locations will be cored down to approximately 6 inches below the depth of previous excavation within each TU boundary. Sanitary sewer and storm drain lines were sometimes installed on bedrock. In these situations, sampling of bedrock will not be performed. If refusal is encountered within 6 inches of the expected depth of the trench, the soil sample will be collected from the deepest section of the core. If refusal is encountered more than 6 inches above the expected depth of the trench, the sample location will be moved to avoid the subsurface obstruction.

To acquire three samples from each location, one surface and one floor sample will be collected from each sample core. The sample cores will be scanned for gamma radiation along the entire length of each core, and the scan data will be evaluated to determine whether collection of a biased sample is required as described in the Parcel G Work Plan (Navy, 2018b). If evaluation of scan data does not identify the need for collection of a biased sample, a biased sample will be collected from the core segment with the highest gamma scan reading that was not already sampled, for a total of at least three samples from each core.

An additional set of 18 systematic samples will be collected from 6 systematic locations representative of the trench sidewalls. The six core locations will be located within 1 meter of the previous sidewall excavation limits and will extend to the maximum previous excavation depth. In the same action described in the previous paragraph, core sections will be retrieved, scanned, and sampled such that at least three samples will be collected from each of the six core locations, resulting in a minimum of 18 systematic samples.

If GPS reception is available, soil sample locations will be position-correlated with GPS data and recorded. If GPS reception is not available, a reference coordinate system will be established to document gamma scan measurement results and soil sample locations. The reference coordinate system will consist of a grid of intersecting lines referenced to a fixed site location or benchmark. If practical, the GPS coordinates of the fixed location or benchmark will be recorded.

Scanning instrumentation used during the investigation of the Phase 2 TUs are described in further detail in the Parcel G Work Plan (Navy, 2018b). A summary of the sampling design and rationale is included in **Worksheet #17**.

#### **Phase 1 Survey Unit**

Phase 1 soil SUs will be characterized in a similar fashion as the RSY process, using a combination of gamma scan surveys and systematic and biased surface soil sampling. Surface soil samples will be collected in accordance with the *Soil Sampling* SOP (Worksheet #21 and Attachment 2).

Gamma scan surveys will be performed as described in the Parcel G Work Plan (Navy, 2018b). If GPS reception is available, gamma scan surveys will be position correlated with GPS data. If GPS reception is not available, which is likely for SUs selected for Phase 1 characterization based on the location within a building crawl space, a reference coordinate system will be established to document gamma scan measurement locations. The reference coordinate system will consist of a grid of intersecting lines referenced to a fixed site location or benchmark. If practical, the GPS coordinates of the fixed location or benchmark will be recorded.

Gamma scanning data sets will be transferred from the data logger onto a computer to create spreadsheets, and if feasible, gamma scan survey results will be mapped. Data obtained during the surface gamma scan surveys will be evaluated to identify areas of elevated activity and locations of biased samples as described in the Parcel G Work Plan (Navy, 2018b).

Following the completion of the gamma scan surveys, a minimum of 18 systematic samples will be collected from each Phase 1 SU. A summary of the sampling design and rationale is included in **Worksheet #17**.

#### **Phase 2 Survey Unit**

Phase 2 SUs will be characterized by systematic surface soil sampling. Surface soil samples will be collected in accordance with the Soil Sampling SOP (Worksheet #21 and Attachment 2). A minimum of 18 systematic samples will be collected from each Phase 2 SU. A summary of the sampling design and rationale for the Phase 2 SUs is included Worksheet #17.

#### Reference Background Area Investigation

Each RBA (Worksheet #17) will be investigated using a combination of gamma scan measurements, and surface and subsurface soil sampling. Surface and subsurface soil samples will be collected in accordance with the *Soil Sampling* SOP (Worksheet #21 and Attachment 2).

At each RBA, 100 percent of the accessible surface (i.e., ground level surface) will be scanned for gamma activity using the instruments specified in Appendix A of the Parcel G Work Plan (Navy, 2018b). Both gross gamma and gamma spectral measurements will be collected simultaneously during the gamma scan. Gamma scan

measurements will be reviewed and accepted as described in Appendix A of the Parcel G Work Plan (Navy, 2018b).

Thirty soil samples, consisting of 5 surface and 25 subsurface soil samples will be collected from each of RBA-1, RBA-2, RBA-3, and RBA-4 (for a total of 120 samples), and 25 surface soil samples will be collected from RBA-Bayview. The sampling design and rationale are described in detail in Appendix A of the Parcel G Work Plan (Navy, 2018b) and summarized in **Worksheet #17**.

#### **Building Investigation**

Buildings will be divided into SUs, and the size and boundary of the SUs will be based on the previous plans and reports (**Worksheet #17**). BMPs will be used to identify boundaries of SUs based on previous TtEC reports (e.g., survey reports, drawings, and sketches) and field observations. Upon receipt of survey instruments for the building investigations and completion of performance checks, background measurements will be obtained in the RBA for each instrument and on each surface type (e.g., concrete, wood, and sheet rock) that is also present in the SUs. The background measurements will consist of a minimum of 18 static measurements on each surface to match the number performed in each SU.

Radiological investigations at these SUs will be conducted to include the following:

- Alpha-beta scan of surfaces.
- Collection of systematic static alpha-beta measurements. A minimum of 18 static alpha-beta static measurements will be taken in each SU.
- Collection of biased static alpha-beta measurement, where necessary based on the alpha-beta scan measurements.
- Collection of swipe samples.
- Collection of building material samples, if necessary.

A summary of the building investigation activities is presented in detail in the Parcel G Work Plan (Navy, 2018b). A summary of the survey design and rationale for the building investigation is included **Worksheet #17**.

#### Assessment of Residual Materials and Equipment

Several buildings contain residual materials and equipment from past operations that will undergo radioactivity surveys in accordance with Appendix B of the Parcel G Work Plan (Navy, 2018b). These surveys may include a combination of surface scans and static measurements and swipe samples. After data evaluation, disposition decisions, and subsequent investigation of the surfaces below the materials and equipment, will be coordinated with the Navy.

### Decontamination and Release of Equipment and Tools

Decontamination of mobilized materials and equipment may be necessary at completion of fieldwork if radioactive materials above RGs are encountered. Disposable equipment will be used whenever applicable and will be disposed of immediately after use. Numerous decontamination methods are available for use. If practical, manual decontamination methods should be used. Abrasive methods may be necessary if areas of fixed contamination are identified. Chemical decontamination can also be accomplished by using detergents for nonporous surfaces with contamination present. Chemicals should be selected for decontamination that will minimize the creation of mixed waste. Decontamination activities will be conducted as described in Appendix B of the Parcel G Work Plan (Navy, 2018b).

### Management of Investigation-derived Waste

It is anticipated that the following waste streams will be generated and managed as indicated in the Parcel G Work Plan (Navy, 2018b).

#### Site Restoration and Demobilization

The open excavations will be backfilled with the excavated soil upon concurrence from RASO. The excavated material will be returned to the same trench from which the material originated. If additional backfill is required, a clean import source will be identified and used. Imported fill will be sampled and analyzed in accordance with the Basewide Radiological Management Plan (TtEC, 2012) or other current guidance and will be approved by RASO before use. If the trench excavations are waterlogged, crushed rock or gravel will be placed as bridging material. With Navy concurrence, radiologically cleared recycled fill materials may be used for backfill. The backfill will be compacted to 90 percent relative density by test method ASTM International D1557. Once the excavated areas have been backfilled, the durable cover will be repaired "in kind" to match pre-excavation action conditions.

#### **Deconstruction of Radiological Screening Yard Pads**

Following completion of radiological screening and with Navy approval, the RSY pads will be deconstructed. Before deconstruction, the RSY pads will be radiologically screened and released. The area will be down-posted for the deconstruction activities. The RSY pad material will be consolidated onsite for offsite disposal at an approved disposal facility. If the RSY pad buffer material cannot be reused onsite, it will be disposed offsite at an approved disposal facility as indicated in the Parcel G Work Plan (Navy, 2018b). Following deconstruction, the area will be restored to pre-removal action conditions.

#### Demobilization

Demobilization will consist of surveying, decontaminating, and removing equipment and materials used during the investigations, cleaning the project site, inspecting the site, and removing temporary facilities. Demobilization activities will also involve collection and disposal of contaminated materials, including decontamination water and disposable equipment for which decontamination is inappropriate.

### Data Management, Verification, and Validation

#### Data Management

Project documentation will be maintained in accordance with **Worksheet #29** and Appendix B of the Parcel G Work Plan (Navy, 2018b). Radiological surveys will be performed and documented in accordance with Appendix B of the Parcel G Work Plan (Navy, 2018b). Sample collection, field measurements, and laboratory data will be recorded electronically to the extent practicable. Electronically recorded data and information will be backed up to a SharePoint site or equivalent on a nightly basis, or as reasonably practical. No data reduction, filtering, or modification will be performed on the original electronic versions of data sets. Data and information recorded on paper will be recorded using indelible ink. Both electronic and paper records of field-generated data will be reviewed by the Field Team Leader, PRSO, or a qualified designee knowledgeable in the measurement method for completeness, consistency, and accuracy. Data manually transferred to paper from electronic data collection devices will be compared to the original data sets to ensure consistency and to resolve noted discrepancies. Electronic copies of original electronic data sets will be preserved on a nonmagnetic retrievable data storage device.

#### **Data Verification**

A Senior QA/QC manager with knowledge of radiological QA/QC will be present in the field for the duration of soil confirmation sampling activities. The QA/QC manager's sole responsibility will be to ensure that the QC measures in the project plans are performed. The QA/QC manager will maintain all QA/QC records for review and provide copies in the final report.

The contractor will conduct weekly QC meetings to keep Navy personnel informed of field progress. The contractor will prepare all meeting materials, including agenda, figures, data, and look-ahead calendar, and provide copies to all participants 24 hours in advance of the meeting. Meeting minutes will be provided to the Navy within 48 hours of the meeting.

Additionally, the Navy has contracted an independent, third-party contractor to oversee and monitor all field activities and ensure that the activities are in compliance with the Parcel G Work Plan (Navy, 2018b) and this SAP.

Additional details regarding data verification are presented in Worksheets #36-36 and #37.

#### **Data Validation**

Analytical data validation will be conducted by an independent third-party data validation subcontractor in accordance with Worksheets #34-#36 and consistent with Navy Environmental Work Instruction No. 1, Data Validation Guidelines for Chemical Analysis of Environmental Samples (NAVFAC SW, 2001), Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) (USEPA et al., 2004), and Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)" (USEPA et al., 2000). USEPA National Functional Guidelines for Inorganic Superfund Data Review (ISM02.2) (USEPA, 2017) may also be applicable.

The data validation findings are summarized in a data validation report. The report content will include an introduction that includes validation guidance used, a summary of the QC elements reviewed, a description of deficiencies, and a summary of the data qualification.

## Data Evaluation and Reporting

Following completion of RBA soil data evaluation, a report will be prepared to include a summary of the field activities, results of gamma scan surveys, and analytical and geotechnical data evaluation. Based on the statistical evaluations, the report will include recommendations for combining similar data sets, and recommendations for selecting values or data sets representing background in soil, and conditions identifying situations when specific values or data sets may not be appropriate. Information from other San Francisco Bay Area radiological background studies may be referenced in the report as appropriate.

Results of radiological investigations for buildings and TUs/SUs complying with the Parcel G ROD RAO will be documented in a RACR, and the building or TU/SU will be recommended for unrestricted radiological release if appropriate. The RACR will document the final radiological status of the building or TU/SU, the results of the survey, remedial activities performed for the building or TU/SU, and the results of the comparison with background.

A Removal Site Evaluation Report will be prepared for buildings and TUs/SUs where additional information is required to support a decision on whether the building or TU/SU complies with the Parcel G ROD RAO. The report will document the results of the radiological investigation, including descriptions of data evaluation results failing to comply with the Parcel G ROD RAO, and recommendations on actions required to demonstrate compliance with the Parcel G ROD RAO. Potential recommendations may include further evaluation using USEPA's current guidance on *Radiation Risk Assessment at CERCLA Sites* (USEPA, 2014a), evaluation of concentrations of ubiquitous fallout to ensure cleanup does not include soil containing only fallout from past nuclear weapons

testing, additional investigations of TUs/SUs or RBAs, alternative statistical evaluations, alternative background evaluations, revisions to the Parcel G ROD, or remedial actions to remove contamination.

The reports generated from work outlined in this SAP will be submitted as preliminary draft, draft, draft final, and final versions. The Navy will be provided with each version for review and comment, and documents will be reviewed and approved by the Navy prior to submittal to regulatory agencies. Response to comment (RTC) matrices will be prepared for each comment set received. The RTCs will be used at each review step to facilitate concurrence of comment responses.

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### SAP Worksheet #15a—Reference Limits and Evaluation Soil Gamma Spectroscopy

Matrix: Soil

Analytical Group: Radiological (gamma spectroscopy) – USEPA Method 901.1

		Duningt Domadiation Cools	Dynicat Downadiation Cool	Duniant Ol Canll	Laboratory-Specific Limits <sup>c,d,e,f</sup>
Analyte	CAS	Project Remediation Goal <sup>a</sup> (pCi/g)	Project Remediation Goal Reference	Project QL Goal <sup>b</sup> (pCi/g)	MDC (pCi/g)
<sup>137</sup> Cs	10045-97-3	0.113	ROD	0.05	0.05
<sup>226</sup> Ra <sup>g</sup>	13982-63-3	1.0	ROD	0.1	0.1
Bismuth-214 ( <sup>214</sup> Bi)	14913-49-6	none		0.1	0.1
Lead-214 ( <sup>214</sup> Pb)	15067-28-4	none		0.1	0.1
Potassium-40 ( <sup>40</sup> K)	13966-00-2	none		0.5	0.5
Actinium-228 ( <sup>228</sup> Ac)	14331-83-0	none		0.3	0.3
Bismuth-212 ( <sup>212</sup> Bi)	14913-49-6	none		1.0	1.0
<sup>212</sup> Pb	15092-94-1	none		0.1	0.1
Americium-241 ( <sup>241</sup> Am)	14596-10-2	none		0.3	0.3
Protactinium-234 ( <sup>234</sup> Pa)	15100-28-4	none		0.75	0.75
<sup>232</sup> Th	7440-29-1	none		0.3	0.3

#### Notes:

- The project remediation goals (RGs) are based on those provided in the Parcel G ROD, (Navy, 2009). The RGs will be applied as concentrations above background.
- b Project Quantitation Limit (QL) goals for individual samples are equal to the MDC and will be a maximum of 90 percent of the RG.
- <sup>c</sup> Results for non-aqueous samples are reported on a dry-weight basis.
- The MDC is an estimate of the smallest true activity (or activity concentration) of an analyte in a sample that results in a 95 percent probability of detection, given a detection criterion that includes a 5 percent probability of false detection in an analyte-free sample. MDCs may vary from sample to sample depending on the composition of the sample matrix. Any changes to these limits that affect the project SAP objectives must be approved by the Navy RPM and QAO in writing in advance of sample testing.
- e Gamma spectroscopy analyses will be based on meeting the MDCs for <sup>137</sup>Cs and <sup>226</sup>Ra. MDCs for other radionuclides analyzed by gamma spectroscopy are not required to be achieved unless specifically requested on the applicable contaminant of concern.
- Daughter products and naturally occurring isotopes will be reported in the gamma spectroscopy results, which may include, <sup>40</sup>K, thallium-208, <sup>212</sup>Bi, <sup>212</sup>Pb, <sup>214</sup>Bi, <sup>214</sup>Pb, radium-223, radium-224, thorium-227, <sup>228</sup>Ac, Thorium-228 (<sup>228</sup>Th), Protactinium-231, <sup>234</sup>Pa, Protactinium-234m.
- g 226Ra background will be established as described in this SAP and the Parcel G Work Plan (Navy, 2018b).

CAS = Chemical Abstracts Service

### SAP Worksheet #15b—Reference Limits and Evaluation Soil Alpha Spectroscopy

#### Matrix: Soil

Analytical Group: Radiological (alpha spectroscopy) - United States Department of Energy (USDOE) Method HASL-300 A-01-R

		Dynain at Dama disting Cools	Project Remediation	Duningt Ol Coalb	Laboratory-Specific Limits <sup>c, d</sup>
Analyte	CAS	Project Remediation Goal <sup>a</sup> (pCi/g)	Goal Reference	Project QL Goal <sup>b</sup> (pCi/g)	MDC (pCi/g)
<sup>226</sup> Ra <sup>e</sup>	13982-63-3	1.0	ROD	0.1	0.1
<sup>241</sup> Am	14596-10-2	none		0.5	0.5
Plutonium-238 ( <sup>238</sup> Pu)	13981-16-3	none	==	0.5	0.5
<sup>239/240</sup> Pu <sup>f</sup>	15117-48-3	2.59	ROD	0.5	0.5
Uranium-234 ( <sup>234</sup> U)	13966-29-5	none		0.5	0.5
235/236Ug	15117-96-1	none		0.175	0.175
<sup>238</sup> U	7440-61-1	none		0.5	0.5
<sup>228</sup> Th	14274-82-9	none		1.0	1.0
Thorium-230 ( <sup>230</sup> Th)	14269-63-7	none		0.5	0.5
<sup>232</sup> Th	7440-29-1	none		1.0	1.0

- <sup>a</sup> The RGs are based on those provided in the Parcel G ROD (Navy, 2009). The RGs will be applied as concentrations above background.
- b Project QL goals for individual samples are equal to the MDC and will be a maximum of 90 percent of the RG.
- c Results for non-aqueous samples are reported on a dry-weight basis.
- The MDC is an estimate of the smallest true activity (or activity concentration) of an analyte in a sample that results in a 95 percent probability of detection, given a detection criterion that includes a 5 percent probability of false-detection in an analyte-free sample. MDCs may vary from sample to sample depending on the composition of the sample matrix. Any changes to these limits that affect the project SAP objectives, must be approved by the Navy RPM and QAO in writing in advance of sample testing.
- Where possible, isotopic analysis for <sup>226</sup>Ra will be performed using the same dissolution/digestion as <sup>238</sup>U to ensure comparability of results. If analysis of <sup>226</sup>Ra is not possible due to interferences, radon emanation (Worksheet #15d) will be performed.
- f 239Pu is listed in the above table as 239/240Pu because the alpha energy peaks for the isotope of plutonium cannot be separated in alpha spectroscopy. Therefore, the laboratory will report as listed above in the table.
- g 235U is listed in the above table as 235/236U because the alpha energy peaks for the isotope of uranium cannot be separated in alpha spectroscopy. Therefore, the laboratory will report as listed above in the table.

### SAP Worksheet #15c—Reference Limits and Evaluation Soil Gas Flow Proportional Counting

#### Matrix: Soil

Analytical Group: Radiological (GFPC) – USEPA Method 905.0 mod

Analyte CA		Project Remediation	Project Remediation	Project QL Goal <sup>b</sup>	Laboratory-Specific Limits <sup>c,d</sup>
	CAS	Goal <sup>a</sup> (pCi/g)	Goal Reference	(pCi/g)	MDC (pCi/g)
<sup>90</sup> Sr	10098-97-2	0.331	ROD	0.15	0.15

- <sup>a</sup> The RGs are based on those provided in the Parcel G ROD, (Navy, 2009). The RGs will be applied as concentrations above background.
- b Project QL goals for individual samples are equal to the MDC and will be a maximum of 90 percent of the RG.
- <sup>c</sup> Results for non-aqueous samples are reported on a dry-weight basis.
- d The MDC is an estimate of the smallest true activity (or activity concentration) of an analyte in a sample that ensures a 95 percent probability of detection, give a detection criterion that includes a 5 percent probability of detection in an analyte-free sample. MDCs may vary from sample to sample depending on the composition of the sample matrix. Any changes to these limits that affect the project SAP objectives must be approved by the Navy RPM and QAO in writing in advance of sample testing.

### SAP Worksheet #15d—Reference Limits and Evaluation Soil Radon Emanation

#### Matrix: Soil

Analytical Group: Radiological (Radon Emanation) - USEPA Method 903.1 mod

Analyte		Project Remediation	Project Remediation	Project QL Goal <sup>b</sup>	Laboratory-Specific Limits <sup>c,d</sup>
	CAS	Goal <sup>a</sup> (pCi/g)	Goal Reference <sup>a</sup>	(pCi/g)	MDC (pCi/g)
<sup>226</sup> Ra <sup>e</sup>	13982-63-3	1.0	ROD	0.1	0.1

- <sup>a</sup> The RGs are based on those provided in the Parcel G ROD, (Navy, 2009). The RGs will be applied as concentrations above background.
- b The Project QL goals for individual samples are equal to the MDC and will be a maximum of 90 percent of the RG.
- <sup>c</sup> Results for non-aqueous samples are reported on a dry-weight basis.
- The MDC is an estimate of the smallest true activity (or activity concentration) of an analyte in a sample that results in s a 95 percent probability of detection, give a detection criterion that includes a 5 percent probability of false detection in an analyte-free sample. MDCs may vary from sample to sample depending on the composition of the sample matrix. Any changes to these limits that affect the project SAP objectives must be approved by the Navy RPM and QAO in writing in advance of sample testing.
- <sup>226</sup>Ra background will be established as described in the Parcel G Work Plan (Navy, 2018b).

### SAP Worksheet #15e—Reference Limits and Evaluation Water Gamma Spectroscopy

Matrix: Water (for field blanks only)

Analytical Group: Radiological (gamma spectroscopy) - USEPA Method 901.1

Analyte		Project Remediation Goal <sup>a</sup> (pCi/L)	Project Remediation Goal Reference	Project QL Goal <sup>b</sup> (pCi/L)	Laboratory-Specific Limits <sup>c,d</sup>
	CAS				MDC (pCi/L)
<sup>137</sup> Cs	10045-97-3	none		15	15
<sup>226</sup> Ra	13982-63-3	none		75	75
<sup>214</sup> Bi	14913-49-6	none		75	75
<sup>214</sup> Pb	15067-28-4	none		75	75
<sup>40</sup> K	13966-00-2	none		150	150
<sup>228</sup> Ac	14331-83-0	none		150	150
<sup>212</sup> Bi	14913-49-6	none		300	300
<sup>212</sup> Pb	15092-94-1	none		30	30
<sup>241</sup> Am	14596-10-2	none		75	75
<sup>60</sup> Co	10198-40-0	none		30	30
<sup>234</sup> Pa	15100-28-4	none		150	150
<sup>232</sup> Th	7440-29-1	none		450	450

The RGs are not applicable for this matrix (i.e., field blanks)

b Project QL goals are equal to the MDC.

The MDC is an estimate of the smallest true activity (or activity concentration) of an analyte in a sample that ensures a 95 percent probability of detection, give a detection criterion that ensures on a 5 percent probability of detection in an analyte-free sample. MDCs may vary from sample to sample depending on the composition of the sample matrix. Any changes to these limits that affect the project SAP objectives must be approved by the Navy RPM and QAO in advance of sample testing.

<sup>&</sup>lt;sup>d</sup> An MDC at or less than the value listed must be achieved for <sup>137</sup>Cs and <sup>226</sup>Ra for all samples for this project. MDCs for other radionuclides analyzed by gamma spectroscopy are not required to be achieved unless specifically requested on the applicable contaminant of concern. pCi/L = picocurie(s) per liter

### SAP Worksheet #15f—Reference Limits and Evaluation Water Alpha Spectroscopy

Matrix: Water (for field blanks only)

Analytical Group: Radiological (alpha spectroscopy) – USDOE Method HASL-300 A-01-R

Analyte		Ducinet Demodistion Cools	Project Remediation Goal Reference Project C	Duniest Ol Coolb	Laboratory-Specific Limits <sup>c</sup>
	CAS	Project Remediation Goal <sup>a</sup> (pCi/L)		(pCi/L)	MDC (pCi/L)
<sup>241</sup> Am	14596-10-2	none		1.0	1.0
<sup>238</sup> Pu	13981-16-3	none		1.0	1.0
<sup>239/240</sup> Pu <sup>d</sup>	15117-48-3	none		1.0	1.0
<sup>226</sup> Ra <sup>f</sup>	13982-63-3	none		1.0	1.0
<sup>234</sup> U	13966-29-5	none		1.0	1.0
235/236Ue	15117-96-1	none		1.0	1.0
<sup>238</sup> U	7440-61-1	none		1.0	1.0
<sup>228</sup> Th	14274-82-9	none		1.0	1.0
<sup>230</sup> Th	14269-63-7	none		1.0	1.0
<sup>232</sup> Th	7440-29-1	none		1.0	1.0

- <sup>a</sup> The RGs are not applicable for this matrix (i.e., field blanks).
- b Project QL goals are equal to the MDC.
- The MDC is an estimate of the smallest true activity (or activity concentration) of an analyte in a sample that ensures a 95 percent probability of detection, give a detection criterion that ensures on a 5 percent probability of detection in an analyte-free sample. MDCs may vary from sample to sample depending on the composition of the sample matrix. Any changes to these limits that affect the project SAP objectives must be approved by the Navy RPM and QAO in advance of sample testing.
- d 239Pu is listed in the above table as 239/240Pu because the alpha energy peaks for the isotope of plutonium cannot be separated in alpha spectroscopy. Therefore, the laboratory will report as listed above in the table.
- e 235U is listed in the above table as 235/236U because the alpha energy peaks for the isotope of plutonium cannot be separated in alpha spectroscopy. Therefore, the laboratory will report as listed above in the table.
- Where possible, isotopic analysis for <sup>226</sup>Ra will be performed using the same dissolution/digestion as <sup>238</sup>U to ensure comparability of results. If analysis of <sup>226</sup>Ra is not possible due to interferences, radon emanation (Worksheet #15h) will be performed.

### SAP Worksheet #15g—Reference Limits and Evaluation Water Gas Flow Proportional Counting

Matrix: Water (for field blanks only)

Analytical Group: Radiological (GFPC) - USEPA Method 905.0 mod

Analyte		Project Remediation	Project Remediation	Project QL Goal <sup>b</sup>	Laboratory-Specific Limits <sup>c</sup> MDC (pCi/L)
	CAS	Goal <sup>a</sup> (pCi/L)	Goal Reference	(pCi/L)	
<sup>90</sup> Sr	10098-97-2	none		2.0	2.0

- <sup>a</sup> The RGs are not applicable for this matrix (i.e., field blanks).
- b Project QL goals for individual samples are equal to the MDC and will be a maximum of 90 percent of the RG.
- The MDC is an estimate of the smallest true activity (or activity concentration) of an analyte in a sample that results a 95 percent probability of detection, give a detection criterion that includes a 5 percent probability of false detection in an analyte-free sample. MDCs may vary from sample to sample depending on the composition of the sample matrix. Any changes to these limits that affect the project SAP objectives must be approved by the NAVFAC Southwest RPM and QAO in writing in advance of sample testing.

### SAP Worksheet #15h—Reference Limits and Evaluation Water Radon Emanation

Matrix: Water (for field blanks only)

Analytical Group: Radiological (Radon Emanation) – USEPA Method 903.1 mod

Analyte		Project Remediation	Project Remediation	Project QL Goal <sup>b</sup>	Laboratory-Specific Limits <sup>c</sup>
	CAS	Goal (pCi/g)	Goal Reference	(pCi/L)	MDC (pCi/L)
<sup>226</sup> Ra	13982-63-3	None		0.1	0.1

- <sup>a</sup> The RGs are based on those provided in the Parcel G ROD, (Navy, 2009).
- b The Project QL goals are equal to the MDC.
- The MDC is an estimate of the smallest true activity (or activity concentration) of an analyte in a sample that ensures a 95 percent probability of detection, give a detection criterion that ensures on a 5 percent probability of detection in an analyte-free sample. MDCs may vary from sample to sample depending on the composition of the sample matrix. Any changes to these limits that affect the project SAP objectives must be approved by the Navy RPM and QAO in advance of sample testing.

# SAP Worksheet #16—Project Schedule/Timeline

		Dates			
Activities	Organization	Anticipated Date of Initiation	Anticipated Date of Completion	Deliverable	
Draft SAP preparation	CH2M	June 2018	July 2018	Draft SAP	
Navy BRAC/RASO SAP review	Navy BRAC and RASO	July 2018	August 2018	Comments and responses	
Navy QAO SAP review	Navy QAO	August 2018	September 2018	Comments and responses, Navy Chemist signature	
Regulatory review	USEPA, DTSC, CDPH, City of San Francisco	September 2018	October 2018	Comments and responses, signature	
Final SAP	Navy and regulatory agencies	October 2018	October 2018	Final SAP	
Subcontracting and chartering	CH2M	October 2018	October 2018	Subcontractor contracts	
Utility locating	CH2M, Perma-Fix, subcontractor	TBD	TBD	None	
Field investigations	CH2M, Perma-Fix	TBD	TBD	None	
Laboratory analyses, data validation and verification, and data management	GEL, TBD, CH2M	TBD	TBD	Analytical and DV reports	
Draft report preparation	CH2M	TBD (within 60 days of completion of the field investigation)	TBD	Draft reports	
Navy BRAC/RASO report review	Navy BRAC and RASO	TBD	TBD	Comments and responses	
Regulatory report review	USEPA, DTSC, CDPH, City of San Francisco	TBD	TBD	Comments and responses	
Report	Navy and regulatory agencies	TBD	TBD	Final report	

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### SAP Worksheet #17—Sampling and Survey Design and Rationale

The proposed Parcel G Evaluation survey, sampling, and analytical program, as well as the rationale for selecting sample locations, is described below.

### Soil Investigation

This section describes the design of radiological investigations, including gamma scanning and soil sample collection in soil. The radiological investigation design and rationale are based on methods, techniques, and instrument systems in the Basewide Radiological Management Plan (TtEC, 2012), with the ultimate requirement to demonstrate compliance with the Parcel G ROD RAO. Previous methodology will be reproduced using BMPs. The purpose of the investigation is to evaluate if concentrations of ROCs are compliant with the RAO in the Parcel G ROD (Navy, 2009). The ROCs for the soil areas are listed in **Table 17-1** and RGs are listed in **Worksheets #15a**, **#15b**, **#15c**, and **#15d**.

The ROCs for the soil investigation are listed in **Table 17-1**. Samples collected in support of each phase of the TU/SU investigation are provided in this worksheet.

Table 17-1. Soil Radionuclides of Concern

Soil Area	Radionuclide of Concern
Former Sanitary Sewer and Storm Drain Lines and Building 351A Crawl Space	<sup>137</sup> Cs, <sup>226</sup> Ra, <sup>90</sup> Sr
Former Buildings 317/364/365 Site	<sup>137</sup> Cs, <sup>226</sup> Ra, <sup>90</sup> Sr, <sup>239</sup> Pu

All soil samples will be analyzed by gamma spectroscopy for <sup>226</sup>Ra and <sup>137</sup>Cs with at least 10 percent of samples receiving gas flow proportional analysis for <sup>90</sup>Sr. Additionally, Phase 2 SU samples collected from the Former Building 317/364/365 Site will also have 10 percent of samples receiving alpha spectroscopy analysis for <sup>239</sup>Pu. If the laboratory results indicate concentrations of <sup>137</sup>Cs above its RG (**Worksheet #15a**), the sample will be analyzed for <sup>90</sup>Sr (**Worksheet #15c**). If the laboratory results indicate the presence of concentrations of <sup>137</sup>Cs or <sup>90</sup>Sr at or above the respective RG (**Worksheets #15a** and **#15c**), additional analysis via alpha spectroscopy for <sup>239</sup>Pu (**Worksheet #15b**) will be performed. For samples with <sup>226</sup>Ra results at or above the RG (**Worksheet #15a**), additional analyses are required to complete a NORM evaluation as described in the Parcel G Work Plan (Navy, 2018b). Analyses using alpha spectroscopy for <sup>238</sup>U along with an analytical method for <sup>226</sup>Ra comparable with alpha spectroscopy for <sup>238</sup>U (e.g., radon emanation) will be performed (**Worksheets #15b** and **#15d**). For that specific sample, the <sup>238</sup>U alpha spectroscopy result will be used as a more representative estimate of the background value for <sup>226</sup>Ra, and the results for <sup>226</sup>Ra will be compared to the RG for <sup>226</sup>Ra using the revised background value.

#### Phase 1 Trench Unit

Radiological investigations will be conducted on a targeted group of 21 of the 63 TUs associated with former sanitary sewer and storm drain lines (Figure 11-1 and Worksheet #18) to evaluate whether concentrations of ROCs are compliant with the RAO in the Parcel G ROD (Navy, 2009). The former TUs selected for Phase 1 investigation were based on their location adjacent to (i.e., downstream and upstream from) impacted buildings and considered the recommendations from the Radiological Data Evaluation Findings Report (Navy, 2017). An example Phase 1 TU location is presented on Figure 17-1.

### SAP Worksheet #17—Sampling and Survey Design and Rationale (continued)

Surveys and sampling will be completed through one of the following methods:

- If the automated soil sorting system process is used, 18 systematic soil samples will be collected from each ESU or SFU during assay with the soil sorting system. Systematic samples will be collected during a given time period, the frequency of which is determined to provide a systematic distribution of sample collection throughout each ESU or SFU. Systematic samples will be collected by compositing material within each 10-minute interval. Samples will be collected from material moving through the soil sorter before discharging into each bin. A minimum of one biased soil sample will be collected from the soil material that has been discharged to the "Diverted Pile" bin. The systematic and biased soil samples will be containerized and submitted to the offsite laboratory with appropriate chain-of-custody documentation as described in Worksheets #21, #26, and #27.
- If RSY pads are used for screening soil, excavated TU material will be assayed using the RSY process. The objective of the processing activities on the RSY pads is to characterize the material. Material that meets the RGs identified in **Worksheet #15a** will be used as backfill material or shipped offsite as non-LLRW. The RSY pad investigation will include gamma scans over 100 percent of the surface area and systematic and biased soil sampling.

A minimum of 18 systematic soil samples will be collected. Data obtained during the surface gamma scan surveys, including gross gamma and individual radionuclide spectral measurements, will be analyzed to identify areas where surface radiation levels appear to be greater than the radionuclide-specific investigation levels using regions of interest-peak identification tools. Elevated areas will be noted on a survey map and flagged in the field for verification. Biased samples will be collected from potential areas of elevated activity displaying gamma scan survey results greater than the investigation level, as described in the Parcel G Work Plan (Navy, 2018b). Each 1,000 m² RSY pad area will be plotted using Visual Sampling Plan (VSP) software (or equivalent) to determine the location of the 18 systematic soil samples. Soil samples will be collected from the surface at a depth of 0 to 6 inches. The systematic and biased soil samples will be containerized, labeled, and shipped to the laboratory, as described in **Worksheets #21**, **#26**, and **#27**.

#### Phase 2 Trench Unit

Radiological investigations will be conducted the remaining 42 TUs in Parcel G associated with former sanitary sewer and storm drain lines (**Figure 11-1** and **Worksheet #18**). Investigations of the Phase 2 TUs will consist of a combination of gamma scan surveys and soil samples.

Within the backfill of each Phase 2 TU boundary, six systematic locations will be cored down to approximately 6 inches below the depth of the previous excavation. Each retrieved core will be scan-surveyed along the entire length of the core. Scan measurement results will be evaluated to investigate the potential for small areas of elevated activity in the fill material. A sample will be collected from the top 6 inches of material, and a second sample will be collected from the 6 inches of material just below the previous excavation depth. Additionally, a third sample will be collected from the core segment with the highest scan reading that was not already sampled. A total of at least three samples will be collected from each core. An example graphic showing the sample locations is provided on **Figure 17-2**.

An additional set of 18 systematic samples will be collected from 6 systematic locations representative of the trench sidewalls. The 6 systematic core locations will be located approximately 6 inches outside of the previous sidewall excavation limits and will extend 6 inches past the maximum previous excavation depth. In the same fashion described in the previous paragraph, core sections will be retrieved, scanned, and sampled such that at least three samples will be collected from each of the 6 core locations, resulting in at least 18 systematic samples.

### SAP Worksheet #17—Sampling and Survey Design and Rationale (continued)

An example graphic showing the sample locations representing the TU sidewalls is provided on **Figure 17-2**. Each TU boundary will be plotted using VSP software (or equivalent) to determine the location of the systematic soil samples. The systematic soil samples will be containerized and submitted to the offsite laboratory with appropriate chain-of-custody documentation as described in **Worksheets #21**, **#26**, and **#27** 

### Phase 1 Survey Unit

The Phase 1 SU investigation will be conducted on a targeted group of 14 of the 28 SUs associated with soil from building sites where only surface soil scanning and sampling were previously conducted (**Figure 11-1**). The name, size, and boundary of the Phase 1 SUs will be based on the previous plans and reports (**Worksheet #18**). The Phase 1 soil area SUs were selected based on the allegations for potential manipulation and/or falsification associated with data from the Building 351A Crawl Space (Navy, 2017). Investigation of Phase 1 SUs will be performed in a similar fashion as the RSY process, using a combination of surface soil gamma scan surveys and systematic and biased surface soil sampling.

Each Phase 1 SU will undergo a 100 percent surface gamma scan of accessible areas using an appropriate instrument as described in the Parcel G Work Plan (Navy, 2018b). The instrument will be composed of a gamma scintillation detector equipped with spectroscopy, which measures gross gamma counts along with radionuclide-specific measurements and is coupled to a data logger that logs the resultant data in conjunction with location. Gross gamma and gamma spectra obtained during the surface gamma scan surveys will be analyzed using region of interest peak identification tools for the ROCs (**Table 17-1**). Elevated areas will be noted on a survey map and flagged in the field for verification. Manual scans using a hand-held instrument may be performed to further delineate suspect areas in the SU. Biased samples will be collected from potential areas of elevated activity displaying gamma scan survey results as described in the Parcel G Work Plan (Navy, 2018b).

Following the completion of the gamma scan surveys, the SU area will be plotted using VSP software (or equivalent) to determine the location of systematic samples. A minimum of 18 systematic soil samples will be collected. An example graphic showing the sample locations is provided on **Figure 17-1**. The systematic and biased soil samples will be containerized and submitted to offsite laboratory with appropriate chain-of-custody documentation as described in **Worksheets #21**, **#26**, and **#27**.

#### Phase 2 Survey Unit

The Phase 2 SU investigation will be conducted on the remaining 14 of 28 SUs in Parcel G (**Figure 11-1**). The name, size, and boundary of the Phase 2 SUs will be based on the previous plans and reports (**Worksheet #18**). The investigation of Phase 2 SUs will be performed by collecting systematic surface soil samples.

The SU area will be plotted using VSP software (or equivalent) to determine the location of systematic soil samples. A minimum of 18 systematic samples will be collected. Cores will be extended to a depth sufficient to collect material from the top 6 inches of soil underneath the durable cover layers. An example Phase 2 SU location is presented on **Figure 17-2**. The systematic soil samples will be containerized and submitted to the offsite laboratory with appropriate chain-of-custody documentation as described in **Worksheets #21**, **#26**, and **#27**.

## Reference Background Area Investigation

The RGs (Worksheet #15a, #15b, and #15c) are incremental concentrations above background; therefore, RBA samples and measurements will be collected and evaluated to provide generally representative data sets estimating levels in natural background and fallout for the majority of soils at HPNS. The RBA characterization will

### SAP Worksheet #17—Sampling and Survey Design and Rationale (continued)

incorporate three survey techniques: gamma scans, surface soil sampling, and subsurface soil sampling to support data evaluations.

Four of the previously established RBA soil areas with minor adjustments to the shape and size of the areas will be used for the RBA investigation. In order to simplify the sampling design, an approximately 20-foot by 20-foot square has been established within each of the four historical RBA footprints. The four historically non-impacted RBA areas are identified as the following:

RBA-1, located on Parcel B RBA-2, located on Parcel C RBA-3, located on Parcel D-1 RBA-4, located on Parcel D-2

These four RBAs are shown on Figure 11-2.

In addition to the four onsite RBAs, an offsite RBA has been identified for surface soil characterization. The City of San Francisco's Bayview Park, located less than 2 miles southwest from the HPNS south gate (Crisp Road), was established in 1915. Bayview Park is non-impacted by the Department of the Navy (Navy) radiological activities and contains areas where surface soil has not been disturbed by construction activities since prior to atmospheric nuclear weapons testing. The area of Bayview Park is occupied by a single large hill, which rises to a height of 425 feet above mean sea level, with a notable rock formation known as Indian Head Rock on the western side of the hill. In 1937, a former radio station building and transmitter were constructed and currently remain intact near the top of the hill. The land area near the radio station building and transmitter has remained undisturbed since 1937 and has been selected as the location of the offsite RBA (RBA-Bayview). The RBA-Bayview is shown on Figure 11-3. Both surface gamma scan surveys and surface soil samples will be collected from RBA-Bayview to provide a more accurate surface soil data set to represent undisturbed surface soil areas. Based on field conditions, additional sample locations at Bayview Park or other reference areas may be added as necessary to characterize different soil types and depositional areas.

RBA investigations will be conducted at five locations (**Worksheet #18**). Figures 17-4 through 17-7 show the planned sample locations from RBAs 1 through 4. Figure 17-8 shows the planned sample locations for RBA-Bayview. The coordinates for the planned sampling locations are provided in Appendix A of the Parcel G Work Plan (Navy, 2018b). The investigation of the RBAs will be performed using a combination of gamma scan measurements and surface and subsurface soil sampling. The gamma scan methodology is included in detail in the Parcel G Work Plan (Navy, 2018b). The sampling design is considered representative of the SU sampling designs in terms of sample depths, spatial distribution, and number of samples to be collected.

The minimum number of samples to be collected was determined based on U.S. Nuclear Regulatory Commission (NRC) criteria, NUREG 1505 Section 13.5 that states four reference areas each with between 10 and 20 samples in each should generally be adequate (NRC, 1998). Therefore, 25 subsurface soil samples will be collected from RBAs 1 through 4 for a total of 100 onsite subsurface soil samples. Five surface soil samples will be collected from RBAs 1 through 4, for a total of 20 onsite surface soil samples. Additionally, 25 soil samples will be collected from RBA-Bayview. Overall, at least 145 soil samples will be collected. Additional data sets may be defined based on soil type or other visual observations of the soil samples.

A central location was randomly selected within RBA-1 through RBA-4. These four randomly selected locations will be used for the center sampling location in each of the four RBAs. Each of the four RBAs are square surface areas measuring approximately 20 feet by 20 feet. Within the 400-square-foot surface area, five sampling locations have been established: one at the center of the square, and the other four located near each of the four corners of the

### SAP Worksheet #17—Sampling and Survey Design and Rationale (continued)

square. Surface soil samples and subsurface soil samples will be collected from the five sampling locations. Surface soil samples will be collected from the top 6 inches of soil material at each location for the surface soil data set. Subsurface soil samples will be collected by drilling to a depth of approximately 10 feet bgs from which five subsurface soil samples will be extracted. The proposed subsurface sample depth intervals are the 1- to 2-foot interval, the 3- to 4-foot interval, the 5- to 6-foot interval, the 7- to 8-foot interval, and the 9- to 10-foot interval. If the geologist determines that lithologic characteristics support modification of the proposed depth increments, additional samples may be collected, or the proposed sample depth may be adjusted, to match the lithologic characteristics of the soil column. Additional information is provided in Appendix A of the Parcel G Work Plan (Navy, 2018b).

RBA-Bayview, located offsite and within Bayview Park, is a square area measuring approximately 150 feet by 150 feet. Within the 22,500-square-foot surface area (2,090 square meters), 25 surface sampling locations have been established using a random start systematic triangular grid pattern. Surface soil samples will be collected from the top 6 inches of soil material at each location (**Figure 17-8**). The coordinates for the planned sampling locations for RBA-Bayview are provided in the Parcel G Work Plan (Navy, 2018b). Additional samples may be collected from other locations within Bayview Park if areas of relatively undisturbed surface soil with varying geological properties are identified during field sampling activities.

Soil sampling will occur at various depths from 0 to 10 feet bgs. The soil samples collected from each of the RBAs will be containerized and submitted to the offsite laboratory with appropriate chain-of-custody documentation as described in **Worksheets #21**, **#26**, and **#27**. RBA samples and measurements will be collected and evaluated to establish representative data sets defining natural background and fallout levels of ubiquitous man-made radionuclides, including the full suite of radionuclides listed in **Worksheets #15a**, **#15b**, **#15c**, and **#15d**.

## **Building Investigation**

This section describes the design of radiological investigations, including scan and static measurements on building surfaces. The radiological investigation design and rationale is based on methods, techniques, and instrument systems in the Basewide Radiological Management Plan (TtEC, 2012), with the ultimate requirement being to demonstrate compliance with the Parcel G ROD RAO. Previous methodology will be reproduced using BMPs. The purpose of the investigation is to evaluate whether concentrations of ROCs are compliant with the RAO in the Parcel G ROD (Navy, 2009). The ROCs and RGs for the building investigation are listed in **Tables 17-2** and **17-3**, respectively.

Table 17-2. Building Radionuclides of Concern

	8			
Building	ROCs	Reference		
Building 351	<sup>137</sup> Cs, <sup>226</sup> Ra, <sup>90</sup> Sr, <sup>232</sup> Th	NAVSEA, 2004		
Building 351A	<sup>137</sup> Cs, <sup>239</sup> Pu, <sup>226</sup> Ra, <sup>90</sup> Sr, <sup>232</sup> Th	NAVSEA, 2004		
Building 366	<sup>137</sup> Cs, <sup>226</sup> Ra, <sup>90</sup> Sr	NAVSEA, 2004		
Building 401	<sup>137</sup> Cs, <sup>226</sup> Ra, <sup>90</sup> Sr	TtEC, 2009c		
Building 408	<sup>137</sup> Cs, <sup>226</sup> Ra, <sup>90</sup> Sr, <sup>232</sup> Th	NAVSEA, 2004		
Building 411	<sup>137</sup> Cs, <sup>60</sup> Co, <sup>226</sup> Ra	NAVSEA, 2004		
Building 439	<sup>137</sup> Cs, <sup>226</sup> Ra	TtEC, 2009a		

### SAP Worksheet #17—Sampling and Survey Design and Rationale (continued)

Table 17-3. Building Remediation Goals

ROC	RGs for Structures (dpm/100 cm²)	RGs for Equipment, Waste (dpm/100 cm²)
<sup>137</sup> Cs	5,000	5,000
<sup>60</sup> Co	5,000	5,000
<sup>239</sup> Pu	100	100
<sup>226</sup> Ra	100	100
<sup>90</sup> Sr	1,000	1,000
<sup>232</sup> Th	36.5	1,000

Note:

dpm/100 cm<sup>2</sup> = disintegration(s) per minute per 100 square centimeters

Radiological investigations will be conducted on impacted buildings, presented on **Figure 11-4**, to evaluate whether concentrations of ROCs are compliant with the RAO in the Parcel G ROD (Navy, 2009). Parcel G buildings will be divided into identifiable SUs similar in area and nomenclature to the previous final status survey of each building. Floor surfaces and the lower 2 meters of remaining wall surfaces will form SUs of no more than 100 m<sup>2</sup> each. The remaining upper wall surfaces and ceilings will form the remaining SUs of no more than 2,000 m<sup>2</sup> each. An example building SU is presented on **Figure 17-3**. Alpha-beta scan, alpha-beta static, biased alpha-beta static measurements where necessary, and alpha-beta swipe samples will be collected from each SU.

Buildings will be durably marked prior to scanning to indicate the intended scan lanes and scan directions. Scan lane widths will be approximately 10 percent smaller than the detector's active width, in the direction of scanning, to ensure overlapping coverage. The total surface area to be scanned will be 100 percent of accessible floor surfaces and 100 percent of the lower 2 meters of remaining wall surfaces using instrumentation described in the Parcel G Work Plan (Navy, 2018b). Twenty-five percent of the remaining upper wall surfaces and ceilings will be scanned.

A minimum of 18 alpha-beta static measurements will be taken in each SU. Biased static measurements will be used to further investigate areas with potential elevated surface activity as described in the Parcel G Work Plan (Navy, 2018b). Swipe samples will be taken at all locations of systematic and biased static measurements. They will be taken dry, using moderate pressure, over an area of approximately 100 cm<sup>2</sup>. Swipe samples will be measured for gross alpha and beta activity using instrumentation described in the Parcel G Work Plan (Navy, 2018b). The surface activity on the sample will be compared to the total surface activity measured by the static measurement to assess the removable fraction of surface activity. This information may be used in any dose or risk assessment performed. Building material samples may be collected for offsite analysis to further characterize areas of interest.

Background measurements will be obtained in the building RBAs for each instrument and on each surface type (e.g., concrete, wood, and sheet rock) that is also present in the SUs. The background measurements will consist of a minimum of 18 static measurements to match the number performed in each SU. The static measurements will be taken on each surface material in the RBA that is representative of the material in the building SUs. The mean instrument- and surface-specific background count rate will be used to update the instrument detection calculations and static count times in the Parcel G Work Plan (Navy, 2018b). The non-impacted first floor of Building 401 will serve as the RBA in the survey of Parcel G buildings (Figure 11-8). Building 401 is known to have been built after 1942 but before 1946, with similar construction to the other buildings. Alternate RBAs may be recommended if needed based on site-specific conditions identified during the building investigations.

Sampling Location	Sample ID <sup>a</sup>	Matrix	Depth (feet bgs) <sup>b</sup>	Analytical Group	Number of Samples	Sampling SOP Reference			
	Phase 1 Trench Unit								
TU69	HPPG-ESU-069A; HPPG-SFU-069A				144				
TU70	HPPG-ESU-070A; HPPG-SFU-070A				180				
TU76	HPPG-ESU-076A; HPPG-SFU-076A				198				
TU77	HPPG-ESU-077A; HPPG-SFU-077A				252				
TU78	HPPG-ESU-078A; HPPG-SFU-078A				126				
TU79	HPPG-ESU-079A; HPPG-SFU-079A				162				
TU95	HPPG-ESU-095A; HPPG-SFU-095A		Excavated material;		126				
TU99	HPPG-ESU-099A; HPPG-SFU-099A		Excavated material representing the sidewalls	Refer to Worksheets #15a, #15b, #15c, and #15d	108				
TU100	HPPG-ESU-100A; HPPG-SFU-100A				36	See <b>Worksheet</b>			
TU101	HPPG-ESU-101A; HPPG-SFU-101A	Soil	and bottoms of TU (depth varies		36	#21			
TU103	HPPG-ESU-103A; HPPG-SFU-103A		depending on historical		54				
TU104	HPPG-ESU-104A; HPPG-SFU-104A		excavated depth)		108				
TU107	HPPG-ESU-107A; HPPG-SFU-107A				54				
TU108	HPPG-ESU-108A; HPPG-SFU-108A				72				
TU109	HPPG-ESU-109A; HPPG-SFU-109A				180				
TU110	HPPG-ESU-110A; HPPG-SFU-110A				180				
TU111	HPPG-ESU-111A; HPPG-SFU-111A				108				
TU117	HPPG-ESU-117A; HPPG-SFU-117A				54				

Sampling Location	Sample ID <sup>a</sup>	Matrix	Depth (feet bgs) <sup>b</sup>	Analytical Group	Number of Samples	Sampling SOP Reference
TU118	HPPG-ESU-118A; HPPG-SFU-118A				108	
TU124	HPPG-ESU-124A; HPPG-SFU-124A				90	
TU153	HPPG-ESU-153A; HPPG-SFU-153A				90	
		Phase 2	Trench Unit			
TU66	HPPG-SFU-066A				18	
TU67	HPPG-SFU-067A				18	
TU68	HPPG-SFU-068A				18	
TU71	HPPG-SFU-071A				18	
TU72	HPPG-SFU-072A				18	
TU73	HPPG-SFU-073A		Sidewall and	Refer to Worksheets #15a, #15b, #15c, and	18	1
TU74	HPPG-SFU-074A		bottom of former TUs;		18	
TU75	HPPG-SFU-075A	Soil	depth varies depending		18	See Worksheet #21
TU80	HPPG-SFU-080A		on historical excavated	#15d	18	
TU81	HPPG-SFU-081A		depth		18	1
TU82	HPPG-SFU-082A				18	
TU83	HPPG-SFU-083A				18	
TU84	HPPG-SFU-084A				18	
TU85	HPPG-SFU-085A				18	-
TU86	HPPG-SFU-086A				18	

Sampling Location	Sample ID <sup>a</sup>	Matrix	Depth (feet bgs) <sup>b</sup>	Analytical Group	Number of Samples	Sampling SOP Reference
TU87	HPPG-SFU-087A				18	
TU88	HPPG-SFU-088A				18	
TU89	HPPG-SFU-089A				18	
TU90	HPPG-SFU-090A				18	
TU91	HPPG-SFU-091A				18	
TU92	HPPG-SFU-092A				18	
TU93	HPPG-SFU-093A				18	
TU94	HPPG-SFU-094A				18	
TU96	HPPG-SFU-096A				18	
TU97	HPPG-SFU-097A				18	
TU98	HPPG-SFU-098A				18	
TU102	HPPG-SFU-102A				18	
TU105	HPPG-SFU-105A				18	
TU106	HPPG-SFU-106A				18	
TU112	HPPG-SFU-112A				18	
TU113	HPPG-SFU-113A				18	
TU114	HPPG-SFU-114A				18	
TU115	HPPG-SFU-115A				18	
TU116	HPPG-SFU-116A				18	

Sampling Location	Sample ID <sup>a</sup>	Matrix	Depth (feet bgs) <sup>b</sup>	Analytical Group	Number of Samples	Sampling SOP Reference
TU119	HPPG-SFU-119A				18	
TU120	HPPG-SFU-120A				18	
TU121	HPPG-SFU-121A				18	
TU122	HPPG-SFU-122A				18	
TU123	HPPG-SFU-123A	-			18	
TU129	HPPG-SFU-129A				18	
TU151	HPPG-SFU-151A				18	
TU204	HPPG-SFU-204A	1			18	
		Phase 1 Soi	l Survey Unit			
	HPPG-351A-SUD0A				18	See Worksheet #21
	HPPG-351A-SUE0A				18	
	HPPG-351A-SUF0A				18	
	HPPG-351A-SUG0A				18	
	HPPG-351A-SUH0A	-			18	
	HPPG-351A-SUIOA	-			18	
Building 351A Crawl	HPPG-351A-SUJ0A	Soil	0 – 0.5	Refer to Worksheets	18	
Space	HPPG-351A-SUK0A	3011	0-0.5	#15a, #15b, #15c, and #15d	18	
	HPPG-351A-SULOA	-			18	
	HPPG-351A-SUM0A				18	
	HPPG-351A-SUNOA	1			18	1
	HPPG-351A-SUO0A	1			18	1
	HPPG-351A-SUP0A				18	
	HPPG-351A-SUT0A				18	

Sampling Location	Sample ID <sup>a</sup>	Matrix	Depth (feet bgs) <sup>b</sup>	Analytical Group	Number of Samples	Sampling SOP Reference				
	Phase 2 Soil Survey Unit									
	HPPG-351A-SUA0A				18					
Building 351A Crawl Space	HPPG-351A-SUB0A				18					
. [-	HPPG-351A-SUC0A				18					
	HPPG-317364365-SU20A				18					
	HPPG-317364365-SU21A				18					
	HPPG-317364365-SU23A		0-0.5	Refer to <b>Worksheets</b> #15a, #15b, #15c, and #15d	18	See <b>Worksheet</b> #21				
	HPPG-317364365-SU24A	Soil			18					
	HPPG-317364365-SU25A				18					
Building 317/364/365 Site	HPPG-317364365-SU26A				18					
	HPPG-317364365-SU27A				18					
	HPPG-317364365-SU28A				18					
	HPPG-317364365-SU29A				18					
	HPPG-317364365-SU30A				18					
	HPPG-317364365-SU31A				18					
	Reference Background Area									
DDA 1	HPRBA1-SS01-000H-0718	Soil	0.0 - 0.5	Refer to Worksheets	5	See Worksheet #21				
RBA-1	HPRBA1-SB01-0102-0718	3011	1-2; 3-4; 5-6; 7-8; 9-10	#15a, #15b, #15c, and #15d	25					

Sampling Location	Sample ID <sup>a</sup>	Matrix	Depth (feet bgs) <sup>b</sup>	Analytical Group	Number of Samples	Sampling SOP Reference	
DDA 2	HPRBA2-SS0-000H-0718	Soil	0.0 – 0.5		5	See Worksheet #21	
RBA-2	HPRBA2-SB01-0102-0718	3011	1-2; 3-4; 5-6; 7-8; 9-10		25	See Worksneet #21	
DDA 2	HPRBA3-SS01-000H-0718	Soil	0.0 - 0.5		5	See Worksheet #21	
RBA-3	HPRBA3-SB01-0102-0718	3011	1-2; 3-4; 5-6; 7-8; 9-10		25 See Worksheet a		
DDA 4	HPRBA4-SS01-000H-0718	- Soil	0.0 – 0.5		5	See Worksheet #21	
RBA-4	HPRBA4-SB01-0102-0718	3011	1-2; 3-4; 5-6; 7-8; 9-10		25	See WOIRSHEEL #21	
RBA-Bayview	HPRBAB-SS01-000H-07-18	Soil	0.0 – 0.5		25	See Worksheet #21	

#### Notes:

- Example sample IDs for sampling have been provided. The site IDs, locations and number of samples collected per site/location are presented in **Worksheet #17** and **#20**. Sample ID instructions are as follows: Sample IDs from the Phase 1 and Phase 2 soil trench unit investigation will use the following format AABB-CCC-NNNA, where AA = facility; BB = site location; CCC = sample type; NNN = former trench unit number; A = alpha-numeric digit (beginning with A, in sequential order, followed by B, C, etc.). Sample IDs from the soil SU investigation will use the following format AABB-CCCC-SUNNA, where AA = facility, BB = site location; CCCC = Building Site name; SUNN = survey unit number; A = alpha-numeric digit (beginning with A, in sequential order, follow by B, C, etc.). Sample IDs from the RBA investigation will use the following format AABBBB-CCDD-EEFF-MMYY where AA = facility; BBBB = site location; CC = sample type; DD = numerical sample location number; EEFF = two-digit sample interval in feet bgs; and MMYY = the two-digit month and year. For equipment blanks the following format AABBBB-CCXX-XXYY where AA = facility; BBBB = site location; CC = sample type; XX = numerical sample number; DD/MM/YYYY = two-digit day/month and 4 digit year.
- b Example depths have been provided for corresponding sample ID. Depths of samples and ID are provided in Worksheet #14.
- <sup>c</sup> These values represent the minimum number of sample locations Additional biased samples may be collected.

Field QC counts are dependent upon the duration of the field event. Frequency of QA/QC collection is as follows:

- Field Blank One per water source for each sampling event
- Equipment Blank For decontaminated equipment, one per type of sampling equipment, per site location; for disposable equipment, one per lot.
- Field duplicates are collected at a frequency of 1 per 10 samples per matrix sent to the laboratory.
- Additional information on sample IDs is presented in Worksheet #27

000H = surface sample collected from 0.0- to 0.5-foot depth interval; "H" for half foot

HP = Hunters Point ESU = Excavation Soil Unit

ID = identification RBA = Reference Background Area

P = field duplicate identifier SB = subsurface sample
PG = Parcel G SFU = sidewall floor unit

SS = surface soil

## SAP Worksheet #19—Field Sampling Requirements

Matrix	Analytical Group	Analytical and Preparation Method/ SOP Reference	Container <sup>a</sup> (number, size, and type)	Sample volume (units)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time
Soil	Radiological (gamma spectroscopy)	USEPA 901.1/ GL-RAD-A-013				180 days (21
Soil	Radiological (alpha spectroscopy)	HASL 300 A-01-R/ GL-RAD-A-011	Gallon size resealable plastic bag or equivalent container	~200 grams	N/A	days for in- growth for gamma
Soil	Radiological (GFPC)	USEPA 905.0 mod/ GL-RAD-A-004		200 grains	IN/A	spectroscopy to be completed within 180
Soil	Radiological (radon emanation)	USEPA 903.1 mod/GL-RAD- A-008				days)

#### Notes:

<sup>&</sup>lt;sup>a</sup> One container for all analyses. Separate containers not required.

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# SAP Worksheet #20—Field Quality Control Sample Summary

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of MS/MSDs	No. of Field Blanks	No. of Equipment Blanks <sup>a</sup>	No. of Proficiency Test Samples	Total No. of Samples to Lab <sup>b</sup>
			Phase 1 TU <sup>b</sup>	•			·	
	Radiological (gamma spectroscopy)	2,466	247	NA	NA	TBD	NA	2,713
Soil	Radiological (alpha spectroscopy)	TBD	TBD	NA	NA	TBD	NA	TBD <sup>cd</sup>
	<sup>226</sup> Ra (radon emanation)	TBD	TBD	NA	NA	TBD	NA	TBD
	Sr-90 (GFPC)	247	25	NA	NA	TBD	NA	272
			Phase 2 TU <sup>b</sup>					
	Radiological (gamma spectroscopy)	1,512	152	NA	NA	TBD	NA	1,664
Soil	Radiological (alpha spectroscopy)	TBD	TBD	NA	NA	TBD	NA	TBD <sup>cd</sup>
	<sup>226</sup> Ra (radon emanation) <sup>d</sup>	TBD	TBD	NA	NA	TBD	NA	TBD <sup>d</sup>
	<sup>90</sup> Sr (GFPC)	152	16	NA	NA	TBD	NA	168
			Phase 1 and 2 SU	b				
	Radiological (gamma spectroscopy)	504	51	NA	NA	TBD	NA	555
Soil	Radiological (alpha spectroscopy)	20	2	NA	NA	TBD	NA	22 <sup>bcd</sup>
	<sup>226</sup> Ra (radon emanation)	TBD	TBD	NA	NA	TBD	NA	TBD⁴
	<sup>90</sup> Sr (GFPC)	51	6	NA	NA	TBD	NA	57

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### SAP Worksheet #20—Field Quality Control Sample Summary (continued)

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of MS/MSDs	No. of Field Blanks	No. of Equipment Blanks <sup>a</sup>	No. of Proficiency Test Samples	Total No. of Samples to Lab <sup>b</sup>		
	Reference Background Area									
	Radiological (gamma spectroscopy)	145	15	NA	NA	TBD	NA	165		
Soil	Radiological (alpha spectroscopy)	145	15	NA	NA	TBD	NA	165		
	<sup>226</sup> Ra (radon emanation)	145	15	NA	NA	TBD	NA	165		
	<sup>90</sup> Sr (GFPC)	145	15	NA	NA	TBD	NA	165		
			Building Investigati	ion						
	Alpha-beta static	18 per SU	TBDe	NA	NA	NA	NA	TBD <sup>f</sup>		
Building Surfaces	Radiological (gamma spectroscopy)	TBD	NA	NA	NA	NA	NA	TBD <sup>g</sup>		
	Radiological (alpha spectroscopy)	TBD	NA	NA	NA	NA	NA	TBD <sup>g</sup>		

#### Notes:

- Equipment Blank For decontaminated equipment, one per type of sampling equipment, per site location; for disposable equipment, one per lot.
- b The minimum number of sampling locations are provided. Additional biased samples may be collected.
- <sup>c</sup> The number of samples will be based on the results of the gamma spectroscopy analysis for <sup>137</sup>Cs and GFPC analysis for <sup>90</sup>Sr, as described in **Worksheets #11 and #17**.
- d The number of samples will be based on the results of the gamma spectroscopy analysis for <sup>226</sup>Ra, as described in **Worksheets #11 and #17**.
- QC of radiological survey measurements will be performed in accordance with the Radiation Protection Plan (Appendix B of the Parcel G Work Plan [Navy, 2018b]. In addition, field duplicate measurements will be performed on 5 percent of systematic static measurements.
- The total number of measurements will be based on the number of SUs within each building. A minimum of 18 static measurements will be collected. Additional biased measurements may be performed.
- <sup>g</sup> Samples of building materials may be collected to further investigate areas of interest.

MS/MSD not applicable to radiological testing

TBD = To be determined

### SAP Worksheet #21—Project Sampling SOP References

Radiological SOPs are specific to the activities being performed, the companies performing the work, and the radioactive material license used. These SOPs include radiological testing activities such as, radiation dose measurements, personnel monitoring, and radiological postings. Further, each company's SOPs may be different based on the requirements of their radioactive material license. Therefore, a comprehensive list and copies of radiological SOPs will be provided by CH2M and Perma-Fix as Attachment B of the Parcel G Work Plan (Navy, 2018b). The following table includes a list of the CH2M field SOPs that apply to the activities in this SAP. For clarity, a comprehensive list of applicable SOPs for each sampling location are provided in the Parcel G Work Plan (Navy, 2018b) and this SAP as appropriate. Refer to **Worksheet #14** for project-specific procedural details.

Title	Date, Revision and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Yes/No)	Comments
Soil Sampling	6/2017	CH2M	Hand Auger, Stainless Bowl, Spoon	No	None
Logging of Soil Borings	6/2017	CH2M	Indelible pen, ruler, logbook, spatula, soil color chart, grain size chart, hand lens, Unified Soil Classification System index charts	No	None
Locating and Clearing Underground Utilities	6/2017	CH2M	Electromagnetic induction instruments (EM-31), Ground Penetrating Radar systems, Magnetic and Optical field methods	No	None
Decontamination of Equipment and Samples	6/2017	CH2M	Buckets	No	None
Preparing Field Logbooks	6/2017	CH2M	Logbook and Indelible Pen	No	None
Chain-of-Custody	6/2017	CH2M	chain-of-custody form	No	None
Packaging and Shipping Procedures for Low-Concentration Samples	6/2017	CH2M	Laboratory-supplied coolers	No	None

Notes:

Field SOPs are presented in Attachment 2.

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## SAP Worksheet #22—Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Equipment	Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference	Comments				
No field instruments for chemical s	No field instruments for chemical screening will be used for this project.										
Ludlum Model 2221 Meter (or equivalent) or Osprey Multichannel analyzer with Bicron 3x5x16 detector (or equivalent); Ludlum Model 2221 Meter (or equivalent) or multichannel analyzer with Ludlum 44-20 (or equivalent); Ludlum Model 2360 meter (or equivalent) with Ludlum Model 43-37 detector (or equivalent); Ludlum Model 3030 Alpha-Beta Sample Counter (or equivalent); Automated soil sorting system (model to be	Calibrate at lab featuring Nation Institute of Standards and Technology traceable standards		ıment procedures are describe	d in detail in Attachment B of the Parcel G	Project RSO, Field Team Lead, or qualified designee	Radiological controls portable instrument procedures are described in detail in Attachment B of	If equipment is deemed inoperable or is malfunctioning, it will be removed from use and				
	Operational checks and verifications	WOLK Flair (Navy, 2018b)			Lead, or qualified designee	the Parcel G Work Plan (Navy, 2018b)	replaced.				
determined); Surface Contamination Monitor (model to be determined).	Maintenance/Inspection										

Notes:

Additional instrumentation may be used as described in the Parcel G Work Plan (Navy, 2018b).

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## SAP Worksheet #23—Analytical SOP References

Lab SOP Number <sup>a</sup>	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
GL-RAD-A-004	The Determination of Strontium 89/90 in Water, Soil, Milk, Filters, Vegetation and Tissues, Revision 18, February 2017	Definitive	Soil - Radiological (GFPC)	Gas Flow Proportional Counter	GEL	N
GL-RAD-A-008	The Determination of Radium-226, Revision 15, January 2018	Definitive	Soil- Radiological (Radon Emanation)	Scintillation Counter	GEL	Y, modified to accommodate determination from soil matrix
GL-RAD-A-011	The Isotopic Determination of Americium, Curium, Plutonium, and Uranium, Revision 26, October 2015	Definitive	Soil - Radiological (alpha spectroscopy)	Alpha Spectrometer	GEL	N
GL-RAD-A-013	The Determination of Gamma Isotopes, Revision 26, February 2017	Definitive	Soil - Radiological (gamma spectroscopy)	Gamma Spectrometer	GEL	N
GL-RAD-A-015	Standard Operating Procedure for Digestion of Soil, Revision 10, February 2017	N/A	Soil - Radiological	N/A	GEL	N
GL-RAD-A-038	Standard Operating Procedure for the Isotopic Determination of Thorium, Revision 17, February 2016	Definitive	Soil - Radiological (alpha spectroscopy)	Alpha Spectrometer	GEL	N
GL-RAD-I-001	Gamma Spectroscopy System Operation, Revision 21, February 2017	N/A	Soil - Radiological (gamma spectroscopy)	Gamma Spectrometer	GEL	N
GL-RAD-A-046	The Determination of Radium-224 and Radium- 226 by Alpha Spectroscopy, Revision 9, July 2016	Definitive	Soil - Radiological (alpha spec)	Alpha Spectrometer	GEL Laboratories, LLC	N
GL-RAD-I-007	Standard Operating Procedure for Ludlum Lucas Cell Counter, Revision 12, March 2017	N/A	Soil - Radiological (Radon Emanation)	Scintillation Counter	GEL	N
GL-RAD-I-009	Standard Operating Procedure for Alpha Spectroscopy System, Revision 15, May 2015	N/A	Soil - Radiological (alpha spectroscopy)	Alpha Spectrometer	GEL	N

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## SAP Worksheet #23—Analytical SOP References (continued)

Lab SOP Number <sup>a</sup>	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
GL-RAD-I-010	Procedure for Counting Room Instrumentation Maintenance, Revision 20, July 2014	N/A	Soil - Radiological	N/A	GEL	N
GL-RAD-I-012	Managing Statistical Data in the Radiochemistry Laboratory, Revision 26, April 2016	N/A	Soil - Radiological	N/A	GEL	N
GL-RAD-I-016	Multi-Detector Counter Operating Instructions, GL-RAD-I-016, Revision 10, April 2015	N/A	Soil-Radiological	N/A	GEL	N

#### Notes:

<sup>&</sup>lt;sup>a</sup> Laboratory SOPs and the gamma spectroscopy library are provided in **Attachment 3** 

## SAP Worksheet #24—Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for CA	SOP Reference <sup>1</sup>
	Initial Calibration (ICAL) (Energy, efficiency and Full Width at Half Maximum [FWHM] peak resolution)	Prior to initial use, following repair or loss of control and upon incorporation of new or changed instrument settings.	The energy difference should be within 0.05% for all calibration points or within 0.2 kiloelectron volt (keV).  Peak energy difference is within 0.1 keV of reference energy for all points.  Peak FWHM < 3 keV at 1332 keV.  The efficiency difference should be within 8% of the true value for each point unless T.C.C. calibration is performed.	Correct problem, then repeat ICAL.		
Gamma Spectrometer	Initial Calibration Verification (ICV)	After ICAL for energy/efficiency and prior to analysis of samples.  Observed peaks of second source standard fall within ± 10% of ICAL value relative to the true value.  Daily or prior to use.  Energy: ±0.5 keV at 60 keV: ±.75 keV at 1332 keV.  Verify second source standard and repeat ICV to check for errors.  If that fails, identify and correct problem and repeat ICV or ICAL and ICV as appropriate.		Analyst/Supervisor		
	Continuing Calibration Verification (CCV) Daily Check				GL-RAD-I-001	
	Background Subtraction Count (BSC) Measurement (Long count for subtracting background from blanks or test sources)	Immediately after ICAL and then performed on at least a monthly basis.	Background count rate of the entire spectrum with $\pm 3\sigma$ of the average.	Recount and check control chart for trends.  Determine cause, correct problem, re-establish BSC.  If background activity has changed, re-establish BSC and reanalyze or qualify all impacted samples since last acceptable BSC.		
	Instrument Contamination Check (ICC) (Short count for controlling gross contamination)	Daily or when working with long count times before and after each analytical batch. Check after counting high activity samples.	No extraneous peaks identified (i.e., no new peaks in the short background spectrum compared to previous spectra); Background count rate of the entire spectrum with ±3σ of the average.	Recount the background. If still out of control, locate and correct problem; reanalyze or qualify all impacted samples since last acceptable ICC.  If background activity has changed, re-establish BSC and reanalyze samples.		
	ICAL (Energy, efficiency, and FWHM peak resolution)	Prior to initial use, following repair or loss of control and upon incorporation of new or changed instrument settings.	3 isotopes within energy range of 3-6 MeV Energy vs. channel slope equation <15 keV per channel. FWHM ≤100 keV for each peak used for calibration. Final peak energy within 20 keV of reference energy Minimum of 3,000 net counts in each peak.	Correct problem, then repeat ICAL.		
Alpha Spectrometer	ICV	After ICAL.	FWHM ≤100 keV  Each peak within ±20 keV ofcorresponding calibration peaks in initial energy calibration.  Minimum 2,000 net counts.  Efficiency within 95% - 105% of ICAL value.	Repeat ICV to check for error.  If that fails, identify and correct problem and repeat ICV or ICAL and ICV, as appropriate.	Analyst/Supervisor	GL-RAD-I-009
	CCV (Pulser check)	Pulser verification daily, prior to analysis of samples.	Gross counts within 5% of the average (20-point minimum). FWHM within 10-20 keV. Energy within ± 40 keV of the average (20-point minimum).	Recount and check control chart for trends.  Determine cause, correct problem, and repeat CCV and all associated samples since last successful CCV.		
	CCV (Check source)	Monthly source check verification prior to analysis of samples.	FWHM ≤100 keV  Each peak within ±30 keV ofcorresponding calibration peaks in initial energy calibration.  Minimum 2,000 net counts.  Efficiency within 95% - 105% of ICAL value.	ecount and check control chart for trends. Determine cause, correct problem, and repeat CV and all associated samples since last uccessful CCV.		

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## SAP Worksheet #24—Analytical Instrument Calibration (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for CA	SOP Reference <sup>1</sup>
Alpha Spectrometer			Use a statistical test to determine a change in the background count rate value.	Check control chart for trends and recount.  Determine cause, correct problem, re-establish BSC.  If background activity has changed, re-establish BSC and reanalyze all impacted samples since last acceptable BSC.	Analyst/Supervisor	GL-RAD-I-009
	ICC	Performed weekly, at minimum, and after counting high activity samples.	Blank ≤3 for blank subtracted (net) activity in all region of influence.	Check control chart for trends and recount.  Determine cause and correct problem.  If background activity has changed, re-establish BSC and reanalyze all infected samples.		
	intersect. The operating voltage should be selected at 50 – 150  volts above the "knee."  Each counting cell is calibrated by spiking a 500-milliliter deionized water sample with known disintegrations per minute of <sup>226</sup> Ra activity. The sample is carried through the entire procedure. The		Correct problem, then repeat ICAL.			
Scintillation Counter (Radon Emanation)			water sample with known disintegrations per minute of <sup>226</sup> Ra activity. The sample is carried through the entire procedure. The procedure is performed 3 separate times to each cell. Calculate cell constant, average and standard deviation from the three runs. Standard deviation needs to be less that 10 % of the cell constant	Correct problem, then repeat ICAL.	Analyst/Supervisor	GL-RAD-I-004
	CCV Daily Check	Daily or prior to use, after any instrument maintenance, or whenever a problem is suspected.	Compared to historical laboratory limits	Correct problem, rerun calibration verification.  If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.		

## SAP Worksheet #24—Analytical Instrument Calibration (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for CA	SOP Reference1
	ICALV (separate plateaus determined for alpha and beta activity)  Prior to initial use and after loss of control.		Slope of the plateau less than 5% over a range of 100V.	Correct problem, then repeat ICALV.		
	Initial Calibration - <u>Efficiency</u> (ICALE)	Prior to initial use, after loss of control, and upon incorporation of new or changed instrument settings.	Verify manufacturer's specifications for detector efficiency for both alpha and beta counting modes using electroplated sources.	Correct problem, then repeat ICALE.		GL-RAD-I-016
	ICAL – <u>Cross-talk Factors</u>	Prior to initial use, after loss of control, and upon incorporation of new or changed instrument settings.	Verify manufacturer's specifications for cross-talk in alpha and beta channels.	Correct problem, then repeat ICALCT.	Analyst/Supervisor	
Gas Flow Proportional Counter	ICAL – <u>Self-Absorption Curve</u>	Prior to initial use, after loss of control, and upon incorporation of new or changed instrument settings.	For each radionuclide of interest (or isotope with similar energy profile), establish mathematical function (curve) of detector efficiency vs. source mass loading.  Best fit of data with coefficient of determination $(r^2) \ge 0.9$ .	Correct problem, then repeat ICALSA.		
	Efficiency Calibration Verification (IECV)	After ICALE for alpha and beta and prior to analysis of samples.	Individual points within ±30% of true value, average of points within ±10% of ICAL value.	Correct problem and verify second source standard. Rerun IECV.  If that fails, correct problem and repeat ICALE.		
	CCV After a counting gas change and daily for short test-source counting intervals.		Within tolerance or control chart limits $\pm3\%$ or $3\sigma$ of the mean.	Correct problem, rerun calibration verification.  If that fails, then repeat ICALE. Reanalyze all samples since the last successful calibration verification.		

Notes:

The specifications in this table meet the requirements of Department of Defense (DoD) Quality Systems Manual (QSM) v.5.1.

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## SAP Worksheet #25—Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Gamma spectrometer	Liquid Nitrogen fill	Physical check	Physical check	Weekly	Acceptable background	<ul> <li>Recalibrate</li> <li>Instrument maintenance</li> <li>Consult with Technical Director</li> </ul>	Analyst/Supervisor	GL-RAD-I-010
Alpha spectrometer	Vacuum Pump Oil replacement     Filter cleaning on the air intake of the instrument cabinet	1, 2. Physical check	1, 2. Physical check	Semi-annually     Quarterly	1, 2. Acceptable background and calibration efficiencies	<ul> <li>Recalibrate</li> <li>Instrument maintenance</li> <li>Consult with Technical Director</li> </ul>	Analyst/Supervisor	GL-RAD-I-010
Gas Flow Proportional Counter	Sample Shelf Cleaning	Physical check	Physical check	Weekly	None applicable	None applicable	Analyst/Supervisor	GL-RAD-I-010
Liquid Scintillation Counter	Window cleaning on Radon Flask Counter	Physical check	Physical check	Weekly	None applicable	None applicable	Analyst/Supervisor	GL-RAD-I-007

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### SAP Worksheet #26—Sample Handling System

#### SAMPLE COLLECTION, PACKAGING, AND SHIPMENT

Sample Collection (Personnel/Organization): Field Team/CH2M

Sample Packaging (Personnel/Organization): Field Team Leader/CH2M or qualified designee

Coordination of Shipment (Personnel/Organization): Field Team Leader/CH2M

Type of Shipment/Carrier: Overnight Carrier/ FedEx

#### **SAMPLE RECEIPT AND ANALYSIS**

Sample Receipt (Personnel/Organization): Sample Receipt Staff/GEL Laboratories, LLC

Sample Custody and Storage (Personnel/Organization): Sample Receipt Staff/GEL Laboratories, LLC

Sample Preparation (Personnel/Organization): Various chemists and technicians /GEL Laboratories, LLC

Sample Determinative Analysis (Personnel/Organization): Various chemists and technicians/ GEL Laboratories, LLC

#### SAMPLE ARCHIVING

Field Sample Storage (No. of days from sample collection): 60 days from receipt

#### SAMPLE DISPOSAL

Personnel/Organization: Sample Disposal Staff/GEL Laboratories, LLC,

Number of Days from Analysis: Any remaining sample volume will be returned under chain-of-custody for archiving to:

Aptim Federal Services
Attn: Randall Kilpack/Aptim

200 Fischer Ave.

Former Hunters Point Naval Shipyard

San Francisco, CA 94124

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### SAP Worksheet #27—Sample Custody Requirements

### Soil Sample Identification Procedures

Each surface and subsurface RBA sample will be given a unique ID number that is carried through the entire process from sample collection to data reporting (see **Worksheet #18**). The former TUs will be excavated and characterized in "batches" that will be given new unique identifiers at the time of excavation. Excavated material representing the backfill material from former TUs and excavated material representing the sidewalls and bottoms of former TUs will be given a unique ID number that is carried through the entire process of sample collection to data reporting (see **Worksheet #18**).

Samples will be assigned an alpha-numeric identifier that will be tied to the sampling location and sampling depth through a separate logbook that will be maintained in the field by the field sampling personnel. The field sampling personnel's logbook will be kept in addition to the chain-of-custody.

### **Field Sample Custody Procedures**

Field sample custody procedures include sample collection, packaging, shipment, and delivery to the laboratory. Custody of field samples will be maintained and custody transfer will be documented from the time of sample collection through receipt of samples at the analytical laboratory using chain-of-custody and custody seal procedures. These requirements will be fulfilled by the Sample Management Coordinator or qualified designee. Each sample will be considered to be in the sampler's custody if one of the following occurs:

- The sample is in the person's physical possession.
- The sample is in view of the person after that person has taken possession.
- The sample is secured so that no one can tamper with the sample.
- The sample is secured in an area that is restricted to authorized personnel.

Samples will be shipped directly from the field to each analytical laboratory. Samples will be packaged and shipped for offsite analysis in accordance with SOP Packaging and Shipping Procedures for Low-Concentration Samples (Worksheet #21 and Attachment 2).

#### Chain-of-custody Procedures

The chain-of-custody record will document the transfer of sample custody from the time of sample collection to laboratory receipt and will accompany the samples from the field to the analytical laboratory. The requirements for sample labels, custody seals, and chains-of-custody are included in in the SOP Chain-of-Custody (Attachment 2). A digital sample documentation/tracking program may be used during the execution of the work plan to provide additional confidence in sample recordkeeping and to add efficiencies to the process.

When custody of the samples is relinquished from one party to another, the individuals involved will sign, date, and record the time of transfer on the chain-of-custody record. The chain-of-custody records may consist of an original top copy and two carbonless copies, or the records may be in a pre-populated electronic format. When using the carbonless chain-of-custody format, the original and first copies will be transmitted to the primary analytical laboratory with the samples. The second copy will be retained in project files for the Field Team Leader, Project Chemist, and Database Manager. Field personnel will sign and date the chain-of-custody forms prior to sealing the cooler and shipping the samples. Field personnel will make a copy of the signed form and scan a copy of each chain-of-custody record to be saved electronically in the project files.

The chain-of-custody record will be completed by each field sampling team using waterproof ink. Corrections will be made with a single line-out, the error will be initialed and dated, and then the correct information will be entered. Empty fields on the chain-of-custody record will be crossed out with a single line or "Z'd" out, with the date and signature entered by the field sampling team. If samples are to be delivered to the laboratory by an

### SAP Worksheet #27—Sample Custody Requirements (continued)

overnight carrier, the airbill number will be recorded, and the chain-of-custody records will be placed in a waterproof plastic bag and taped to the inside lid of the sample cooler prior to sealing with appropriate secure tape and custody seals. These requirements will be fulfilled by the field sampling personnel.

#### **Custody seals**

Custody seals will be placed on the outside of each sample cooler so that the seals must be broken to open. After field samples are placed into coolers, two or more custody seals will be placed on the outside of the cooler prior to shipment or transport. Each custody seal will be initialed and dated by the field sampling team, affixed to the cooler, and taped over using clear strapping tape.

### Field Logbook

Field notes will be kept in bound, weatherproof logbooks. Notes will be taken with waterproof, nonerasable ink. Field staff completing separate tasks will keep separate logbooks, as necessary, according to the SOP *Preparing Field Logbooks* (Worksheet #21 and Attachment 2).

#### **Laboratory Sample Custody Procedures**

Laboratory sample custody procedures include the receipt of samples, archiving, and disposal. Custody of samples will be maintained and custody transfer will be documented from the time of sample receipt through sample disposal by the analytical laboratory consistent with the analytical laboratory's SOP for maintaining sample integrity (SOP GL-LB-E-012).

The analytical laboratories will have established custody procedures, which include the following:

- Designation of a sample custodian
- Completion by the custodian of the chain-of-custody record, any sample tags, and laboratory request sheets, including documentation of sample condition upon receipt
- Laboratory sample tracking and documentation procedures
- Secure sample storage with the appropriate environment (e.g., refrigerated, dry), consistent with analytical method requirements
- Proper data logging and documentation procedures, including custody of original laboratory records

Upon arrival of the samples at the analytical laboratory, a sample custodian will take custody of the samples, assess the integrity of sample containers, and verify that the information on the sample labels matches the information on the associated chain-of-custody record. The laboratory will restrict access to the storage areas to authorized laboratory personnel only, to prevent unauthorized contact with samples, extracts, or documentation. The sample custodian will maintain security of the samples in accordance with the analytical laboratory SOP.

Soil and field QC water samples will be retained by the laboratory for 60 days after final sample results are reported. Any remaining sample volume will be returned under chain-of-custody to HPNS for archiving.

## SAP Worksheet #28a—Laboratory QC Samples Soil Gamma Spectroscopy

Matrix: Soil

Analytical Group: Radiological (gamma spectroscopy)

Analytical Method/SOP Reference: USEPA Method 901.1/GL-RAD-A-013

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria	
Method Blank	One per prep batch of	No analytes detected < reportable detection limit or less than 5% associated sample activity	Correct problem. If required, re-prepare and reanalyze method blank (MB) and all samples processed with the contaminated blank.		Bias/Contamination		
Laboratory Control Sample	20 or fewer samples of similar matrix or one per day, whichever comes first	Recovery Limits: <sup>137</sup> Cs: 75-125% <sup>60</sup> Co: 75-125% <sup>241</sup> Am: 75-125%	Identify problem; if not related to matrix interference, re-reanalyze LCS and all associated batch samples	Analyst/ Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits	
Laboratory Duplicate		RPD ≤25% and/or relative error ratio (RER) ≤1	Correct problem, then re- reanalyze all samples processed with the duplicate		Precision		

Notes:

DoD QSM v5.1 limits do not exist and the laboratory SOP limits will be used.

## SAP Worksheet #28b—Laboratory QC Samples Soil Alpha Spectroscopy

Matrix: Soil

Analytical Group: Radiological (alpha spectroscopy)

Analytical Method/SOP Reference: USDOE Method HASL-300 A-01-R/ GL-RAD-A-011

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria	
Method Blank	One per prep batch	No analytes detected > MDC	Correct problem. If required, reprepare and reanalyze MB and all samples processed with the contaminated blank.		Bias/Contamination		
Laboratory Control Sample	of 20 or fewer samples of similar matrix or one per day, whichever comes first	Recovery Limits:  241 Am: 75-125%  238 Pu: 80-127%  239/240 Pu: 75-125%  238 U: 75-125%  226 Ra: 75-125%  232 Th: 75 – 125%	Identify problem; if not related to matrix interference, re-reanalyze LCS and all associated batch samples	Analyst/ Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits	
Tracer	Per sample, blank, LCS, MS, MSD	Barium-133 tracer: 15- 125% Plutonium-242 tracer: 15–1250% Uranium-232 tracer: 15- 125% Thorium-229 tracer: 15– 125%	Truncate tracers above 100% recovery to eliminate low biased results. Re-prepare and reanalyze sample if carrier is low (indicating high biased results) if there is activity in the sample above the reporting limit. No reanalysis if matrix interference is nonconformance during sample preparation		Accuracy/Bias		

Notes:

DoD QSM v5.1 limits do not exist and the laboratory SOP limits will be used.

## SAP Worksheet #28c—Laboratory QC Samples Soil Gas Flow Proportional Counting

Matrix: Soil

Analytical Group: Radiological (GFPC)

Analytical Method/SOP Reference: USEPA Method 905.0 mod/ GL-RAD-A-004

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria	
Method Blank	One per prep batch	No analytes detected > MDC	Correct problem. If required, reprepare and reanalyze MB and all samples processed with the contaminated blank.		Bias/Contamination		
Laboratory Control Sample	samples of similar matrix or one per day, whichever	Recovery Limits: 75- 125%	Identify problem; if not related to matrix interference, re-reanalyze LCS and all associated batch samples		Accuracy/Bias		
Laboratory Duplicate	comes first	RPD ≤25% and/or RER ≤1	Correct problem, then re-reanalyze all samples processed with the duplicate	Analyst/ Supervisor	Precision	Same as Method/ SOP QC Acceptance	
Carrier	Per sample, blank, LCS, MS, MSD	Strontium and Yttrium carriers: 40-110%	Truncate Carriers above 100% recovery to eliminate low biased results. Reprepare and reanalyze sample if carrier is low (indicating high biased results) if there is activity in the sample above the reporting limit. No reanalysis if matrix interference is nonconformance during sample preparation		Accuracy/Bias	Limits	

Notes:

DoD QSM v5.1 limits do not exist and the laboratory SOP limits will be used.

## SAP Worksheet #28d—Laboratory QC Samples Soil Radon Emanation and Scintillation Counting

Matrix: Soil

Analytical Group: Radiological (Radon Emanation)

Analytical Method/SOP Reference: USEPA Method 903.1 mod/ GL-RAD-A-008

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria
Method Blank		No analytes detected > MDC	Correct problem. If required, reprepare and reanalyze MB and all samples processed with the contaminated blank.		Bias/Contamination	
Laboratory Control Sample	One per prep batch of 20 or fewer samples of similar	Recovery Limits: 75- 125%	Identify problem; if not related to matrix interference, re-reanalyze LCS and all associated batch samples		Accuracy/Bias	
Laboratory Duplicate	matrix or one per day, whichever comes first	RPD ≤25% and/or RER ≤1	Correct problem, then re-reanalyze all samples processed with the duplicate	Analyst/	Precision	Same as Method/ SOP QC Acceptance Limits
Matrix Spike		Recovery Limits: 75- 125%	Identify problem; if LCS recovery is acceptable, indicating possible matrix interference, no further CA necessary	Supervisor	Accuracy/Bias	

Notes:

DoD QSM v5.1 limits do not exist and the laboratory SOP limits will be used.

## SAP Worksheet #29—Project Documents and Records

Document	Where Maintained <sup>a</sup>
APP and Work Plan with SAP	Project file and NAVFAC Southwest Administrative Record
Field notes/logbooks	Project file
Chain-of-custody forms	Project file and analytical laboratory
Laboratory raw data	Analytical laboratory, project file, NAVFAC Southwest Administrative Record
Field audits/reports	Project file
Corrective Action Report	Project file and analytical laboratory
Laboratory equipment maintenance logs	Project file and analytical laboratory
Sample preparation	Project file, analytical laboratory, and NAVFAC Southwest Administrative Record
Run logs	Project file, analytical laboratory, and NAVFAC Southwest Administrative Record
Sample disposal	Project file and analytical laboratory
CLP-equivalent (Stage 4) analytical laboratory reports, including raw data	Project file and NAVFAC Southwest Administrative Record
Hard copy data validation reports	Project file and NAVFAC Southwest Administrative Record

### Notes:

<sup>&</sup>lt;sup>a</sup> Files will be stored for a minimum of 7 years in accordance with the CLEAN 9000 contract requirement. Documents submitted to the NAVFAC Southwest Administrative Record will be consistent with the NAVFAC Southwest Environmental Work Instruction No. 6 (NAVFAC SW, 2005).

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### SAP Worksheet #30—Analytical Services

Matrix	Analytical Group	Sample Locations/ ID Number	Analytical Method	Data Package Turnaround Time	Laboratory/Organization (name and address, contact person and telephone number)	Backup Laboratory/ Organization <sup>a</sup> (name and address, contact person and telephone number)	
	Gamma Spectroscopy		USEPA Method 901.1		CFL Laboratoria II C		
Soil.	Alpha Spectroscopy	See <b>Worksheets</b> #18	USDOE Method HASL 300 A-01-R	28 calendar	GEL Laboratories, LLC 2040 Savage Road Charleston, SC 30407	TDD	
Soil	GFPC	and <b>#20</b>	USEPA Method 905.0 mod	days for full deliverable	deliverable (	Charleston, SC 29407 (843) 556-8171 POC: Valerie Davis	TBD
	Radon Emanation		USEPA Method 903.1 mod		FOC. Valetie Davis		

### Notes:

Samples will be analyzed by laboratories that are accredited by the DoD Environmental Laboratory Accreditation Program (ELAP) (Attachment 4).

GEL Laboratories DoD ELAP Certification Number 2567.01 (A2LA), Valid to June 30, 2019. Status of laboratory certifications/accreditations will be verified prior to fieldwork and before samples are delivered to the laboratory. Updates to laboratory accreditation to ensure the laboratory is qualified to perform the analysis will be made prior to sample testing.

<sup>&</sup>lt;sup>a</sup> A backup laboratory has not been identified. If circumstances render the subcontracted laboratory unable to perform the analytical services, another laboratory will be determined at that time.

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# SAP Worksheet #31—Planned Project Assessments

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing CA (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Operational Readiness Review (ORR)	Project startup	Internal	CH2M	Radiological STC CH2M	PM CH2M	PM CH2M	Radiological Lead CH2M
Field Sampling Technical Systems Audit (TSA)	At least one field TSA at the start of field activities	Internal	CH2M	Program Chemist (designee) CH2M	Field Team Leader CH2M	Field Team Leader CH2M	Radiological Lead CH2M
Data Review TSA	During field sampling and analysis through validation	Internal	CH2M	PM, Program Chemist CH2M	Field Team Leader (CH2M), Project Chemist, and Analytical Laboratory Manager	Project Chemist, Program Chemist (CH2M), and Analytical Laboratory Manager	Program Chemist CH2M
Quality Assurance/Quality Control	Project startup through completion of field investigation	Internal	CH2M	Quality Assessment Manager, CH2M Corporate Quality Assessment Manager, CH2M	PM, CH2M	PM, CH2M Quality Assessment Manager, CH2M	Quality Assessment Manager, CH2M

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# SAP Worksheet #32—Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Time Frame of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Time Frame for Response	
ORR	ORR Checklist	Kim Henderson PM CH2M	As soon as possible, within same day of finding	ORR Checklist with outstanding actions completed or addressed prior to project work.	Kim Henderson PM CH2M	1 business day	
		TBD Field Team Leader CH2M	As soon as possible within same day of finding		Kevin Smallwood Field Team Leader CH2M	1 business day	
	Audit form (See Attachment 5) showing results of field audit. If CAs are necessary and cannot be	Kim Henderson PM CH2M	1 business day	Completed Audit Form indicating all CAs taken. Additional documentation will be attached as necessary. Audit form is issued by the STC.	indicating all CAs taken.	Kim Henderson PM CH2M	1 business day
Field Sampling TSA	implemented during the audit, these deficiencies will be noted and their resolution will be	Anita Dodson Program Chemist CH2M	1 business day		Anita Dodson Program Chemist CH2M	3 business days	
	documented in the CA Report.	Danielle Janda/ George (Patrick) Brooks LRPM/BLTL Navy	1 business day if CA involving > 1 day delay is necessary		Danielle Janda/ George (Patrick) Brooks LRPM/BLTL Navy	Included with summary report	
Data Review TSA	Memo or written audit report	Anita Dodson Program Chemist CH2M	1 business day	Letter or e-mail	Anita Dodson Program Chemist CH2M	3 business days	

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# SAP Worksheet #33—QA Management Reports

Type of Report	Frequency (daily, weekly, monthly, quarterly, annually)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
Provides an overview of sampling, decontamination, and data storage procedures     Identifies QC samples and summarizes associated analytical results     Summarizes the findings of the analytical data validation process     Provides an evaluation of data quality in accordance with the data quality indicator (DQIs) as defined in the SAP	Once for all data per parcel	Approximately 60 days after field investigation is complete	Program Chemist, CH2M STC, CH2M Project Chemist, CH2M	Navy LRPM/BLTL
Laboratory System Audit Reports	During DoD ELAP assessment or renewal of DoD ELAP certification	To be determined by DoD ELAP if offsite lab audit/ recertification is required	DoD ELAP Laboratory Evaluator	DoD ELAP POC (DoD ELAP) Laboratory Quality Assurance Managers
Field Sampling TSA Report	Once	Approximately 30 days after completion of audit	STC, CH2M	Navy LRPM/BLTL

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# SAP Worksheet #34-36—Data Verification and Validation (Steps I and IIa/IIb) Process

Data Review Input	Description	Responsible for Verification or Validation <sup>a</sup>	Step I/ Ila/IIbª	Internal/External <sup>b</sup>
Field Notebooks	Field notebooks will be reviewed internally and placed into the project file for archival at project closeout.	Field Team Leader/CH2M	Step I	Internal
Chains of Custody and Shipping Forms	Chain-of-custody forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the chain-of-custody will be initialed by the reviewer, a copy of the chains-of-custody retained in the site file, and the original and remaining copies taped inside the cooler for shipment. Chains-of-custody will also be reviewed for adherence to the SAP by the project chemist.	Field Team Leader/CH2M Project Chemist/CH2M	Step I	Internal & External
Sample Condition upon Receipt	Any discrepancies, missing, or broken containers will be communicated to the project chemist in the form of laboratory logins.	Project Chemist/CH2M	Step I	External
Documentation of Laboratory Method Deviations	Laboratory Method Deviations will be discussed and approved by the project chemist. Documentation will be incorporated into the case narrative which becomes part of the final hardcopy data package.	Project Chemist/CH2M	Step I	External
Electronic Data Deliverables	Electronic Data Deliverables (EDDs) will be compared against hardcopy laboratory results (10 percent check). Discrepancies will be resolved with the laboratory.	Project Chemist/CH2M	Step I	External
Case Narrative	Case narratives will be reviewed by the data validator during the data validation process. This is verification that they were generated and applicable to the data packages.	Data Validator/CH2M	Step I	External
Laboratory Data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	Respective Laboratory QAO	Step I	Internal
Laboratory Data	The data will be verified for completeness by the project chemist. In order to ensure completeness, EDDs will be compared to the SAP. This is a verification that all samples were included in the laboratory data and that correct analyte lists were reported.	Project Chemist/CH2M	Step I	External
Audit Reports	Upon report completion, a copy of all audit reports will be placed in the site file. If CAs are required, a copy of the documented CA taken will be attached to the appropriate audit report in the QA site file. Periodically, and at the completion of site work, site file audit reports and CA forms will be reviewed internally to ensure that all appropriate CAs have been taken and that CA reports are attached. If CAs have not been taken, the site manager will be notified to ensure action is taken.	PM/CH2M Project Chemist/CH2M	Step I	Internal
Corrective Action Reports	Corrective action reports will be reviewed by the project chemist or PM and placed into the project file for archival at project closeout.	PM/CH2M Project Chemist/CH2M	Step I	External
Laboratory Methods	During the pre-validation check, ensure that the laboratory analyzed samples using the correct methods specified in the UFP-SAP. If methods other than those specified in the SAP were used, the reason will be determined and documented.	Project Chemist/CH2M	Step Ila	External
Target Compound List and Target Analyte List	During the pre-validation check, ensure that the laboratory reported all analytes from each analysis group in accordance with <b>Worksheet #15</b> . If the target compound list is not correct, then it must be corrected prior to sending the data for validation. Once the checks are complete, the PM is notified via e-mail.	Project Chemist/CH2M	Step Ila	External
Reporting Limits	Ensure the laboratory met the project-designated QLs shown in <b>Worksheet #15</b> . If QLs were not met, the reason will be determined and documented.	Project Chemist/CH2M	Step IIb	External
Field SOPs	Ensure that all field SOPs were followed.	Field Team Leader/CH2M	Step I	Internal
Laboratory SOPs	Ensure that approved analytical laboratory SOPs were followed.	Respective Laboratory QAO	Step I	Internal
		1	1	<u>.</u>

## SAP Worksheet #34-36—Data Verification and Validation (Steps I and IIa/IIb) Process (continued)

Data Review Input	Description	Responsible for Verification or Validation <sup>a</sup>	Step I/ IIa/IIbª	Internal/External <sup>b</sup>
Laboratory Data	A compliance check will be performed to compare the documented receipt conditions and analytical QC results in the data package to acceptance criteria this SAP and validation guidelines referenced in <b>Worksheet #14</b> .	Data Validator/TBD	Step IIa	External
Raw Data	20 percent review of instrument outputs and recalculation checks of raw data to confirm identifications and laboratory calculations. For a recalculated result, the data validator attempts to re-create the reported numerical value. The laboratory is asked for clarification if a discrepancy is identified which cannot reasonably be attributed to rounding. In general, this is outside 5 percent difference.	Data Validator/TBD	Step IIa	External
Onsite Screening	All non-analytical field data will be reviewed against SAP requirements for completeness and accuracy based on the field calibration records.	Field Team Leader/CH2M	Step IIb	Internal
Documentation of Method QC Results	Establish that all required QC samples were run and met limits.	Data Validator/TBD	Step IIa	External
Documentation of Field QC Sample Results	Establish that all required QC samples were run and met limits.	Project Chemist/CH2M	Step IIa	Internal
DoD ELAP Evaluation	Ensure that each laboratory is DoD ELAP Certified for the analyses they are to perform. Ensure evaluation timeframe does not expire.	Project Chemist/CH2M	Step I	External
	Analytical methods and laboratory SOPs as presented in this SAP will be used to evaluate compliance against QA/QC criteria. Should adherence to QA/QC criteria yield deficiencies, data may be qualified. Data may be qualified if QA/QC exceedances have occurred and is summarized in Table 34_36-1. Guidance and qualifiers from MARLAP (USEPA et al., 2004), MARSSIM (USEPA et al., 2000), and USEPA National Functional Guidelines for Inorganic Superfund Data Review (ISM02.2) (USEPA, 2017) may also be applicable.			
	Of the analytical data, 100 percent will be validated by a third-party data validation subcontractor, with 20 percent of the sample delivery groups subject to Stage 4 validation and 80 percent subject to Stage 2B validation.			
Analytical data for radiological parameters in all samples.	Stage 4 data validation follows the USEPA protocols and criteria set forth in the functional guidelines for inorganic and radiological data review (USEPA et al., 2000, 2004; USEPA, 2017). These guidelines apply to analytical data packages that include the raw data (e.g., spectra and chromatograms) and backup documentation for calibration standards, analysis run logs, laboratory control samples (LCSs), dilution factors, and other types of information. This additional information is used in the Stage 4 data validation process for checking calculations of quantified analytical data. Calculations are checked for QC samples (e.g., matrix spike [MS]/matrix spike duplicate [MSD] and LCS data) and routine field samples (including field duplicates, field and equipment rinsate blanks). To ensure that detection limit and data values are appropriate, an evaluation is made of instrument performance, method of calibration, and the original data for calibration standards.	Data Validator/TBD	Step IIa and IIb	External
	Under the Stage 2B data validation effort, the data values for primary and QC samples are generally assumed to be correctly reported by the laboratory. Data quality is assessed by comparing the QC parameters listed in the previous paragraph to the appropriate criteria (or limits) as specified in this SAP, by DoD-QSM v5.1 requirements, or by method-specific requirements (e.g., EPA, DOE). If calculations for quantitation are verified, it is done on a limited basis and may require raw data in addition to the standard data forms normally present in a data package.			

### Notes

<sup>&</sup>lt;sup>a</sup> Verification (Step I) is a completeness check that is performed before the data review process continues in order to determine whether the required information (complete data package) is available for further review. Validation (Step IIa) is a review that the data generated is in compliance with analytical methods, procedures, and contracts. Validation (Step IIb) is a comparison of generated data against measurement performance criteria in the SAP (both sampling and analytical). Should CH2M find discrepancies during the verification or validation procedures above, an e-mail documenting the issue will be circulated to the internal project team, and a Corrections to File Memo will be prepared identifying the issues and the CA. This Memo will be sent to the laboratory, or applicable party, and maintained in the project file.

b Internal or external is in relation to the data generator.

# SAP Worksheet #34-36—Data Verification and Validation (Steps I and IIa/IIb) Process (continued)

<b>Quality Control Check</b>	Evaluation	Data Qualification	Samples Affected
Holding Time	Holding time exceeded for extraction, digestion, or analysis	J = positive results; Nondetects = use professional judgment –	· UJ or R All analytes in sample
Sample Preservation	N/A	None required	
Temperature	N/A	None required	
CAL (See <b>Worksheet #24</b> for criteria)			
Energy	Energy difference outside criteria	Sample > MDC; qualify as estimated (J) Sample < MDC; qualify as estimated (UJ)	Associated analytes in all samples in analytical batch
Efficiency	Efficiency difference outside criteria	Sample > MDC; qualify as estimated (J) Sample < MDC; qualify as estimated (UJ)	
FWHM peak resolution	FWHM peak resolution outside criteria	Sample > MDC; qualify as estimated (J) Sample < MDC; qualify as estimated (UJ)	
ICV	Observed peaks in ICV greater than 10% of ICAL value	Sample > MDC; qualify as estimated (J) Sample < MDC; qualify as estimated (UJ)	Associated analytes in all samples in analytical batch
CCV (Daily Check)	Energy, efficiency, or FWHM outside criteria	Sample > MDC; qualify as estimated (J) Sample < MDC; qualify as estimated (UJ)	Associated analytes in all samples in analytical batch
BSC	Background count rate of entire spectrum > 3σ of the average	Sample > MDC; qualify as estimated (J) Sample < MDC; qualify as estimated (UJ)	All associated samples in analytical batch
ICC	Background count rate of entire spectrum > 3σ of the average	Sample > MDC; qualify as estimated (J) Sample < MDC; qualify as estimated (UJ)	All associated samples in analytical batch
LCS	%R >UCL	Sample > MDC; qualify as estimated (J) Sample < MDC; None required	Associated analytes in all samples in preparation batch or analytical batch
	%R <lcl 30%<="" but="" td="" ≥=""><td>Sample &gt; MDC; qualify as estimated (J) Sample &lt; MDC; qualify as estimated (UJ)</td><td></td></lcl>	Sample > MDC; qualify as estimated (J) Sample < MDC; qualify as estimated (UJ)	
	%R <30%	Sample > MDC; qualify as estimated (J) Sample < MDC; qualify as unusable (R)	
Method Blank	Blank < MDC	None required	Associated analytes in all samples in preparation batch or analytical batch
	Blank > MDC	Sample < MDC; None required Sample > MDC by < 10x blank; qualify as estimated (J) Sample > 10x blank; None required	
Tracer Recovery (alpha spectroscopy only)	%R >UCL	Sample > MDC; qualify as estimated (J) Sample < MDC; None required	Associated analytes in affected samples
Carrier Recovery (GFPC ony)	%R <lcl 10%<="" but="" td="" ≥=""><td>Sample &gt; MDC; qualify as estimated (J) Sample &lt; MDC; qualify as estimated (UJ)</td><td></td></lcl>	Sample > MDC; qualify as estimated (J) Sample < MDC; qualify as estimated (UJ)	
	%R <10%	Sample > MDC; qualify as estimated (J) Sample < MDC; qualify as unusable (R)	

# SAP Worksheet #34-36—Data Verification and Validation (Steps I and IIa/IIb) Process (continued)

### Table 34\_36-1. Data Validation Guidance for Data Qualification

<b>Quality Control Check</b>	Evaluation	Data Qualification	Samples Affected
Laboratory Control Sample Duplicates	Concentration of reported analytes are > 5x the MDC in either sample and RPD $\geq$ 25% and/or RER $\geq$ 1	Sample > MDC; qualify as estimated (J) Sample < MDC; qualify as estimated (UJ)	Analytes in parent sample
	Concentration of reported analytes are < 5x the MDC in either sample and absolute difference > 3x MDC	Sample > MDC; qualify as estimated (J) Sample < MDC; qualify as estimated (UJ)	
Matrix Spike <sup>1</sup>	%R >UCL	Sample > MDC; qualify as estimated (J) Sample < MDC; None required	Associated analytes in all samples in preparation batch or analytical batch
	%R <lcl 30%<="" but="" td="" ≥=""><td>Sample &gt; MDC; qualify as estimated (J) Sample &lt; MDC; qualify as estimated (UJ)</td><td></td></lcl>	Sample > MDC; qualify as estimated (J) Sample < MDC; qualify as estimated (UJ)	
	%R <30%	Sample > MDC; qualify as estimated (J) Sample < MDC; qualify as unusable (R)	
Field Duplicates	Concentration of reported analytes are > 5x the MDC in either sample and RPD $\geq$ 25% and/or RER $\geq$ 1	Sample > MDC; qualify as estimated (J) Sample < MDC; qualify as estimated (UJ)	Analytes in parent sample and field duplicate
	Concentration of reported analytes are < 5x the MDC in either sample and absolute difference > 3x MDC	Sample > MDC; qualify as estimated (J) Sample < MDC; qualify as estimated (UJ)	

### Notes:

< = less than

> = greater than

All QA/QC criteria are included in Worksheets #12, #24, and #28 and will be used for validation criteria.

 $^{1}$ If activity of the sample > 5 times the spiking level.

%R = percent recovery

LCL = lower control limit

UCL = upper control limit

### SAP Worksheet #37—Usability Assessment

The DQO for the project include the following goals:

- To evaluate and document the validity of the obtained radiological data to support decisions
- To corroborate prior survey results if necessary
- To compare radiological data to RGs.
- To recommend additional remediation if necessary
- To compare radiological data to applicable natural background values.

Assessment of sampling and survey data consists of four separate and identifiable phases: data reduction, data verification, data validation, and DQA. These processes will be performed in accordance with MARLAP (USEPA et. Al, 2004) and other applicable guidance. Data reduction involves data transformation processes such as converting raw data into reportable quantities and units, using significant figures, and calculating measurement uncertainties. Verification and validation pertain to evaluation of survey and analytical data and are considered as two separate processes.

Data verification compares the survey and sampling data collection against the requirements of the project-specific Work Plan and SOPs. For example, the actual survey locations, scan speed, number and location of systematic static survey measurements, and the number and location of swipe samples will be compared with the planned survey activities. A verification report may be prepared depending on the size and complexity of the survey. The verification report identifies those requirements that were not met (called exceptions). Task-specific verification checklists will be developed in accordance with MARLAP Section 8.5 prior to field mobilization to ensure that requirements identified in the work planning documents are met. Data verification also involves reviewing data that was transcribed or transferred into the electronic data management systems. The data verification will be performed by the radiological STC and other senior staff with access to the original data, SOPs, and the Parcel G Work Plan (Navy, 2018b).

At HPNS, the verification process will include the following:

- Appropriate selection of the survey instruments
- Appropriate survey methods for the ROCs
- Evaluation of data completeness
- Verification of instrument/detector calibration
- Daily response checks of the instrument/detector
- Assessment of survey method specifications, including scan speed, distance from the detector to surveyed surface, survey path, time that counts are collected, and adherence to operator response requirements, such as response to measurements exceeding the investigation level and documentation of adverse conditions
- Retrospective calculation of MDCs
- Adjustments of background count rate settings
- Checks on instrument system performance
- Swipes collected as required: labeling, analyses, and documentation
- Recorded measurement and sample locations per project requirements

Validation is a systematic check on the set of survey or analytical data being used to meet the project requirements and is performed to addresses the usability of the data. The validation process begins with a review of the survey or analytical data package to identify its areas of strength and weakness. The validation process should determine the impact of not meeting the requirements of the Parcel G Work Plan (Navy, 2018b) and SOPs. Validation then evaluates the data to determine the absence of a required survey measurement and the uncertainty of the survey process. During validation, the technical reliability and the degree of confidence in the reported survey data are considered. The validator will note if data that do not meet the performance criteria (Worksheet #28). The products of the validation process are validated data and a statement on which data are acceptable and which data are sufficiently inconsistent that it should not be used in the decisions for which the survey data was collected.

DQA is the last phase of the data collection process, and consists of a scientific and statistical evaluation of project-wide knowledge to assess data usability. DQA considers all sampling, analytical, and data handling details, external QA assessments, and other historical project data to determine the usability of data for decision-making. To assess and document overall data quality and usability, the data quality assessor integrates the data validation report, field information, assessment reports, and historical project data, and compares the findings to the DQOs objectives defined in the Parcel G Work Plan (Navy, 2018b) and this SAP. The DQA process uses the combined findings of these multi-disciplinary assessments to determine data usability for the intended decisions, and to generate a DQA report documenting that usability and the causes of any deficiencies.

The DQA process varies depending on the survey objectives, and the level and depth of the verification. The process will evaluate and document the usability of the data by considering the project DQIs, which are precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS). The DQA process will determine whether the data will be suitable for the intended needs of the project. Every data type (e.g., sampling, field screening data, and laboratory analytical data) will be relevant to the usability assessment. Data usability will include the entry of analytical data validation flags, applied by the third-party analytical data validation subcontractor, to the project data, as well as an overall assessment of the analytical data and field QC samples.

The assessment will consider the relationship of each type of data to the entire data set, and the adequacy of the data to fulfill the project DQOs. The data will be assessed for correctness, completeness, and compliance to method- or project-specific QA/QC requirements, including the results of the independent analytical data validation process and contractual requirements. Analytical data validation will evaluate the data based on the PARCCS criteria defined in this SAP and other method-specific performance requirements. The overall assessment process will also evaluate data usability based on the intended use of the data. The intent of the DQA process will be to establish the PARCCS levels and usability of the final results with respect to the project DQOs. Upon completion of analytical data validation, each data point will be assessed as non-qualified, qualified as estimated ("J" or "UJ" qualified), or qualified as rejected ("R" qualified) based upon the acceptance criteria, and analytical data validation flags will be added to the project data. These parameters will be based on the analytical data quality and will encompass the DQIs established in this SAP. Qualification will be given according to each sample's delivery group and will be based on the SAP and applicable laboratory and data validation SOPs. Both analytical and contractual compliance and completeness levels will be assessed for each analytical parameter. Finally, the overall usefulness of the data will be established as related to the project DQOs.

### **Data Quality Indicators**

Quantifiable criteria, known as measurement performance criteria, are presented in **Worksheet #12**. The PARCCS criteria will be the qualitative and quantitative indicators of data quality. The PARCCS criteria are defined and discussed as follows.

### Precision

Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision will be measured by using laboratory duplicates and field duplicate samples. It will be expressed in terms of the RPD as follows:

$$RPD = \frac{|C_1 - C_2|}{(C_1 + C_2)/2} \times 100$$

where:

RPD = relative percent difference  $C_1$  = concentration of sample or MS  $C_2$  = concentration of duplicate or MSD

For the evaluation of precision between the native sample and its associated field duplicate, the sample results must be greater than 5 times the MDC in order for the RPD criteria (See **Worksheet #12**) to apply. When either the sample or field duplicate results are less than 5 times the MDC, then the RER must be less than 1 using the following equation:

$$RER = \frac{\left| S - D \right|}{2\sigma s + 2\sigma d}$$

where:

RER = relative error ratio

S = concentration of sample
D = concentration of duplicate

S = uncertainty of sample result

d = uncertainty of duplicate result

If either the RPD or RER fail the criteria, the native sample and field duplicate results will be qualified as estimated ("J" flag). Other site-specific field duplicate and laboratory duplicate results will be evaluated for trends and if the exceedance is due to the sample matrix or field sample collection, as well as if resampling is warranted. This evaluation and any impact related to ROCs will provided in the DQA.

### Accuracy

Accuracy is the degree of agreement of an observed measurement (or an average of the same measurement type) with an accepted reference or true value. Accuracy of analytical determinations will be measured using laboratory QC analyses such as LCSs and surrogate spikes. Accuracy will be measured by evaluating the actual result against the known concentration added to a spiked sample and will be expressed as %R as shown below:

$$\%R = \frac{S - U}{C_{sa}} \times 100$$

where:

%R = Percent Recovery

S = Measured concentration of spiked aliquot
 U = Measured concentration of unspiked aliquot

 $C_{sa}$  = Concentration of spike added

### Representativeness

Representativeness is the reliability with which a measurement or measurement system reflects the true conditions under investigation. Representativeness is influenced by the number and location of the sampling points, sampling timing and frequency of monitoring efforts, and the field and laboratory procedures. The representativeness of data will be maintained by the use of established field and laboratory procedures and their consistent application.

### Comparability

Comparability expresses the confidence with which one data set can be compared to another based on using USEPA-defined procedures, where available. If USEPA procedures are not available, the procedures have been defined or referenced in this SAP.

The comparability of data will be established through well documented methods and procedures, standard reference materials, QC samples, performance-evaluation study results, and by reporting each data in consistent units.

### Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions. Analytical data validation and DQA will determine which data will be valid and which data will be rejected. Percent completeness will be defined as follows:

Percent Completeness = 
$$\frac{V}{T} \times 100$$

where:

V = Number of valid (not rejected) measurements over a given time

T = Total number of planned measurements

The completeness goal for this project will be 90 percent for valid, usable data. If the completeness goal of the project is not achieved, a discussion on the limitations on the use of the project data will be included in the Usability Assessment section of the DQA.

### Sensitivity

Sensitivity is the measure of a concentration at which an analytical method can positively identify and report analytical results. The sensitivity of an analytical method will be indicated by the project-required reporting limits, as compared to the RGs.

### **Detection and Quantitation Limits**

The MDC is an estimate of the smallest true activity (or activity concentration) of an analyte in a sample that ensures a 95 percent probability of detection, give a detection criterion that ensures on a 5 percent probability of detection in an analyte-free sample. The MDCs are contractually specified minimum detection limits for specific analytical methods and sample matrices.

For this project, concentrations below the MDC will be reported as "U" to the MDC.

### Describe the evaluative procedures used to assess overall measurement error associated with the project:

The usability assessment process will consist of reviewing the analytical data validation reports for usable analytical data (i.e., no validation qualifications or estimated "J"/"UJ" qualifications) and rejected ("R" qualified) analytical data, as well as evaluating the field and analytical data for discrepancies or deviations. This assessment will evaluate the impact of the discrepancies or deviations on the usability of the data and assesses whether the necessary information has been provided for use in the decision-making process. The assessment will evaluate whether there were deviations in sampling activities (e.g., incorrect sample location, improper or malfunctioning sampling equipment, or incorrect analysis performed), chain-of-custody documentation, or holding times; compromised samples (i.e., damaged or lost samples) and the need to resample; or changes to SOPs or methods that could potentially affect data quality.

An evaluation of QC sample results will be performed to assess whether unacceptable QC results (e.g., blank contamination) affect data usability.

Other parameters to be evaluated during the usability assessment may include, but will not be limited to, the following:

- Matrix effects—matrix conditions that might have affected the performance of the extraction or analytical method
- Site conditions—unusual weather conditions or site conditions that might have affected the sampling plan
- Identifying critical and noncritical samples or target analytes
- Background or historical data
- Data restrictions—data that do not meet the project DQOs or were "R" qualified might be restricted, but usable, as qualitative values for limited decision-making purposes

### Identify the personnel responsible for performing the usability assessment:

Project Chemist, CH2M, Mark Cichy

Data Validation Subcontractor, TBD

The project team will be consulted as appropriate to determine final usability of the collected data.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented, so that they identify trends, relationships (correlations), and anomalies:

DQA/Data Usability Assessment will be reported in the Confirmation Survey Report.

The data will be evaluated for overall PARCCS criteria for each matrix, analytical group, and concentration level, and data use limitations will be discussed in the DQA/Data Usability Assessment Reports for data that do not meet the project DQOs or DQIs. The DQA/Data Usability Assessment reports will include a detailed discussion of the data usability evaluations with sufficient information to support the data usability conclusions, such as the following:

- a detailed description of the regulatory requirements and technical bases for assessment
- review of data reduction, verification and validation

- assessment of trends and biasesequilibrium of radionuclide decay chains
- · analysis of environmental radioactivity
- variations of natural radionuclides
  - satisfaction of quality objectives
  - overall defensibility and usability
  - appropriate analysis to support usability.

The level of data verification, validation, and DQA performed on radiological samples is defined in **Worksheet** #34-36. Copies of surveys, sampling, and analytical data (and their supporting data) will be protected and maintained in project record files.

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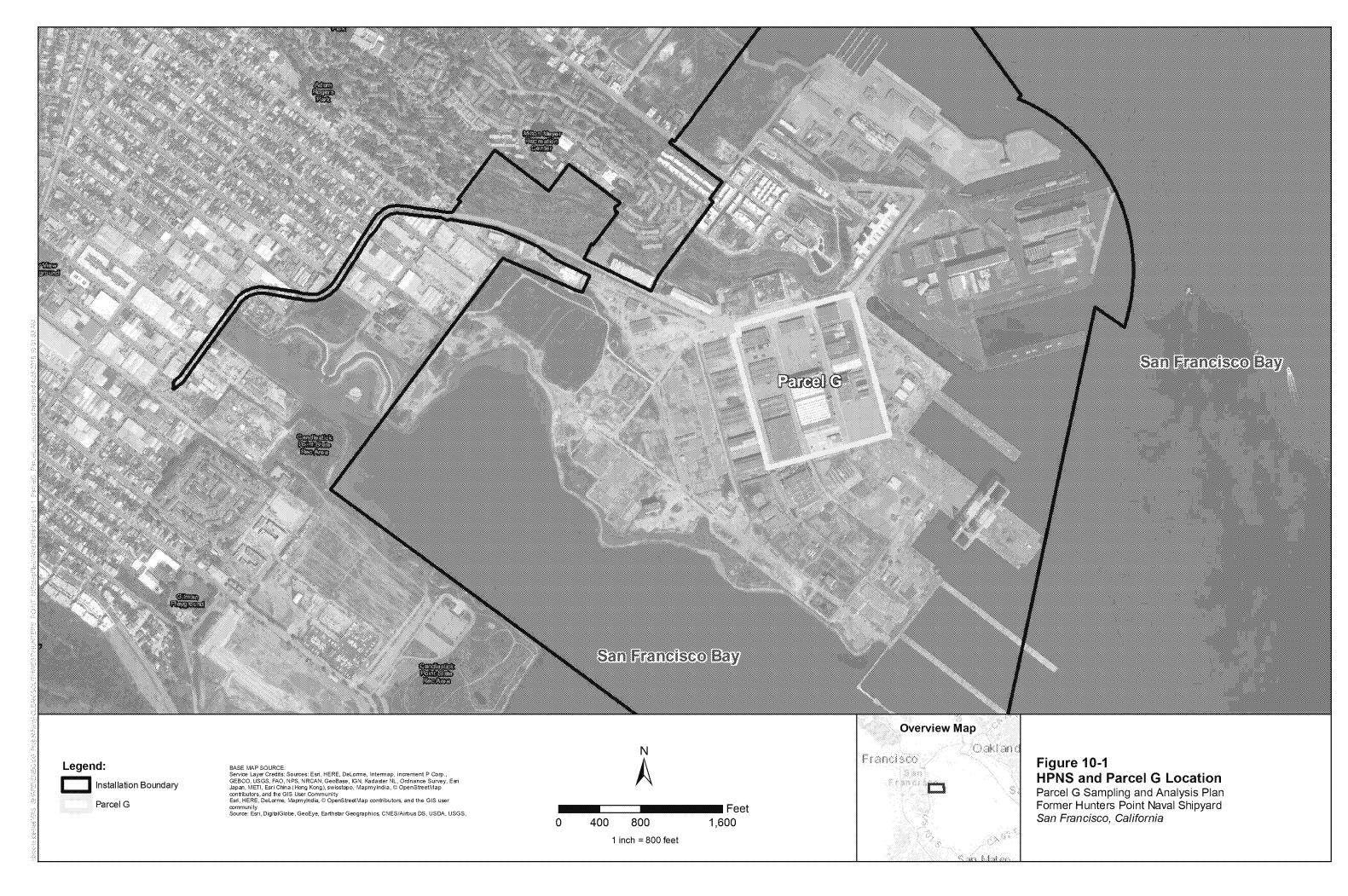
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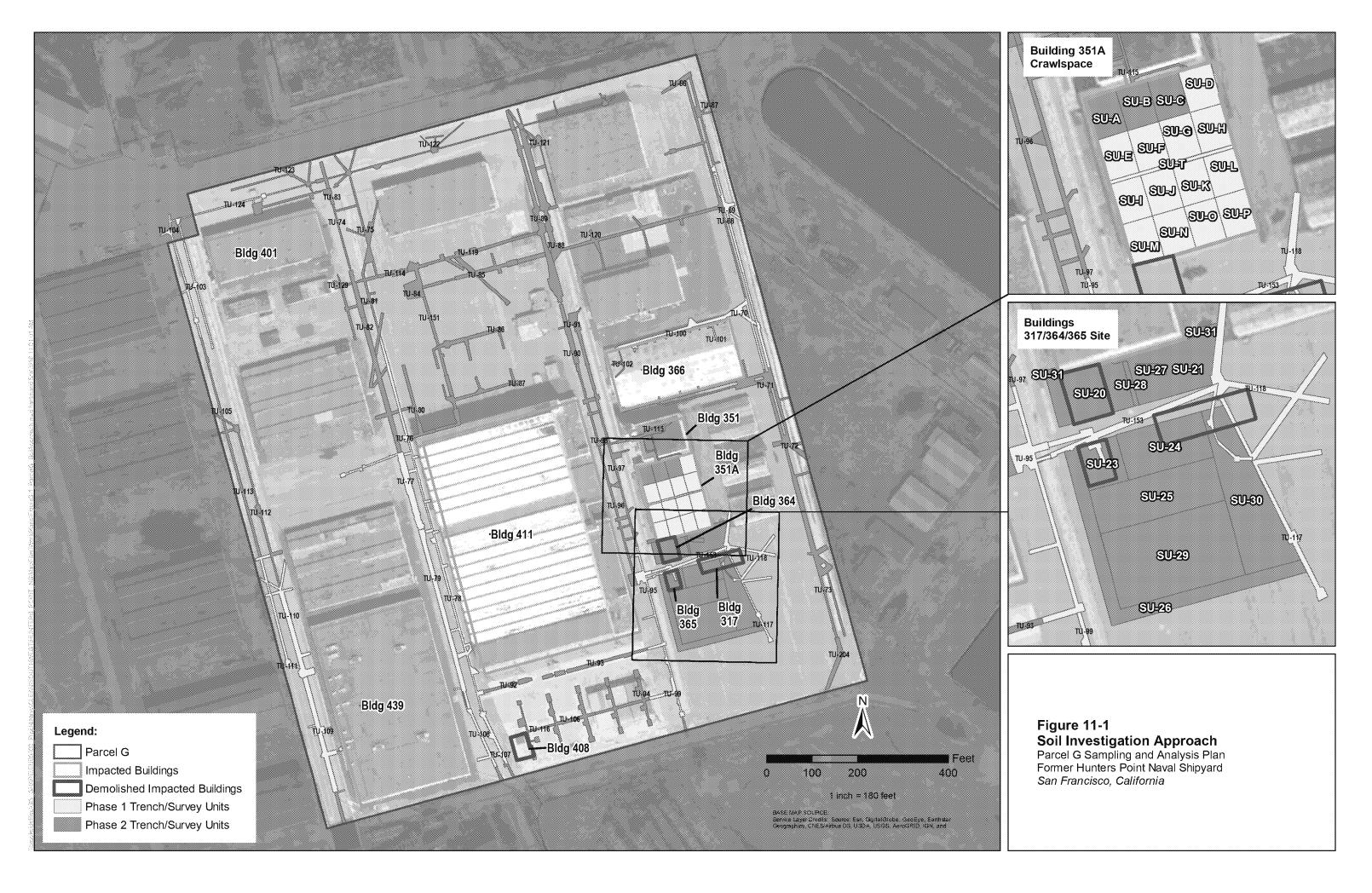
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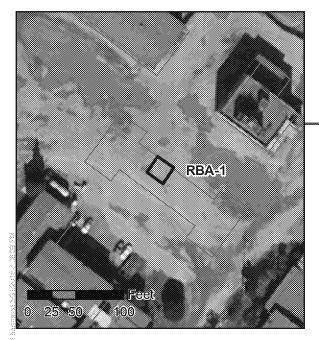
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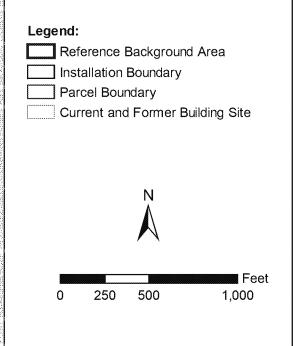
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Figures







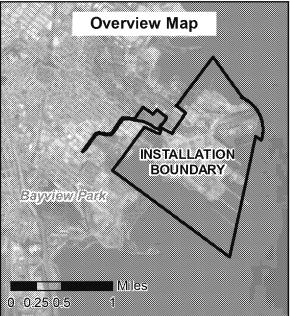


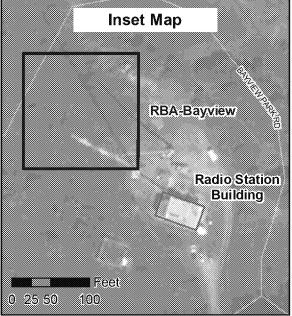
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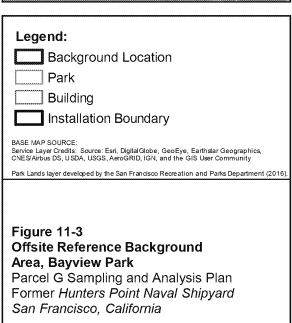
Figure 11-2
HPNS Reference Background Areas
Parcel G Sampling and Analysis Plan
Former Hunters Point Naval Shipyard
San Francisco, California

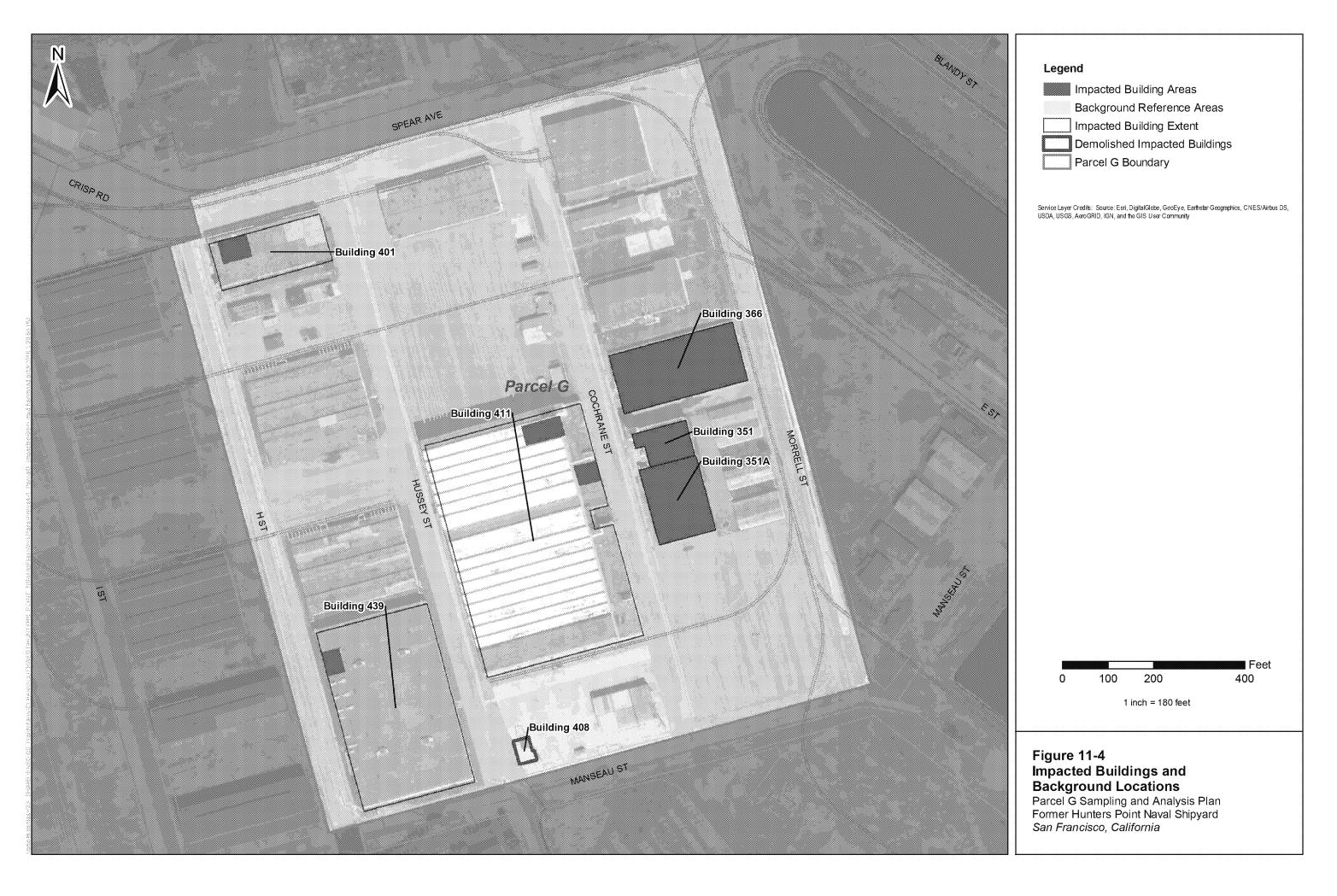


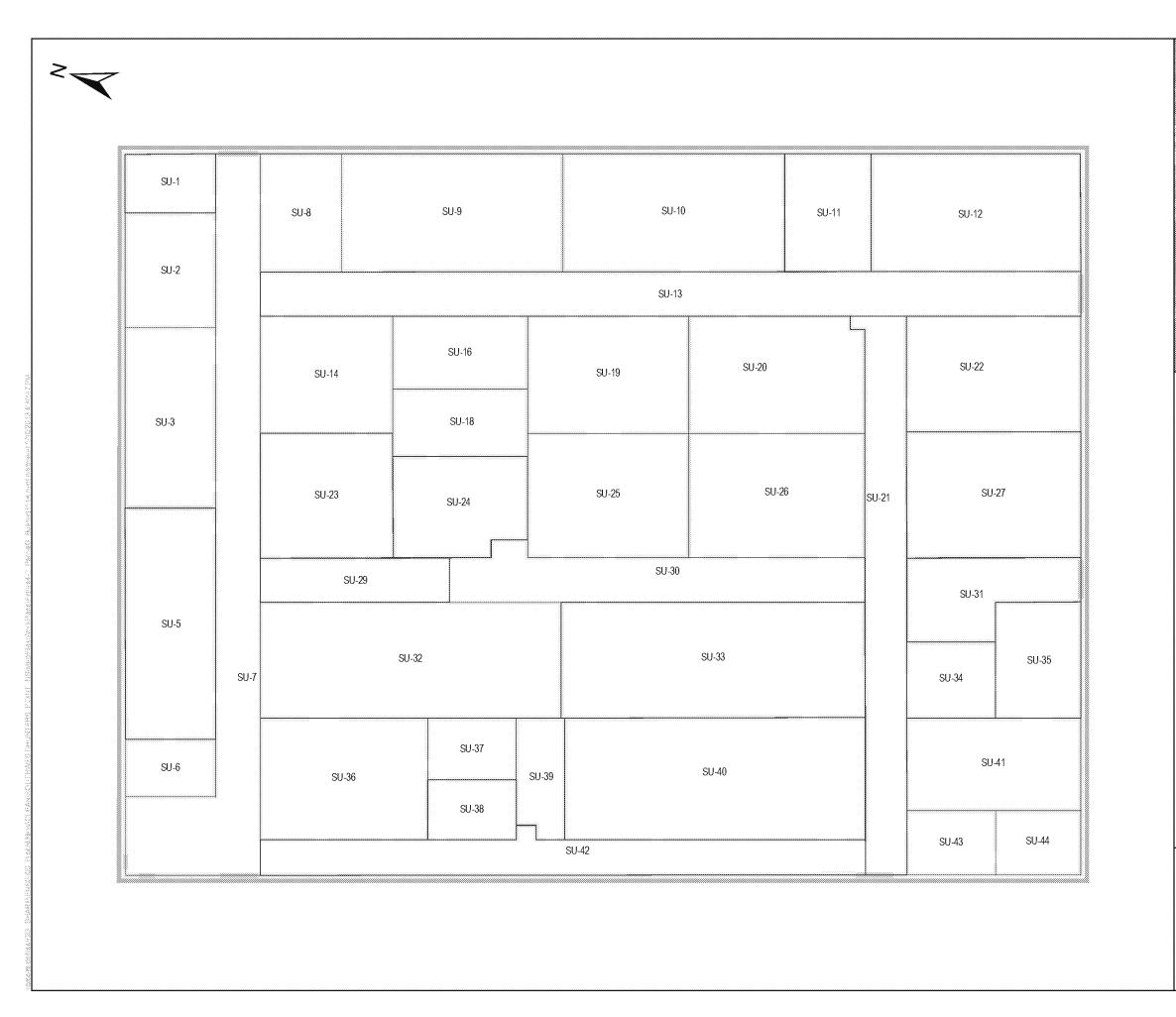












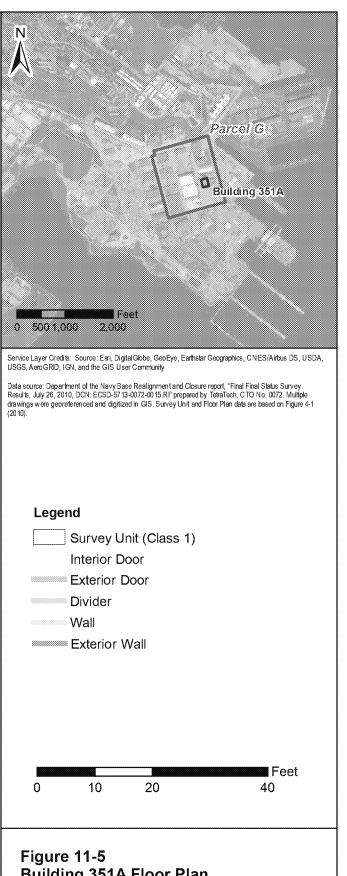
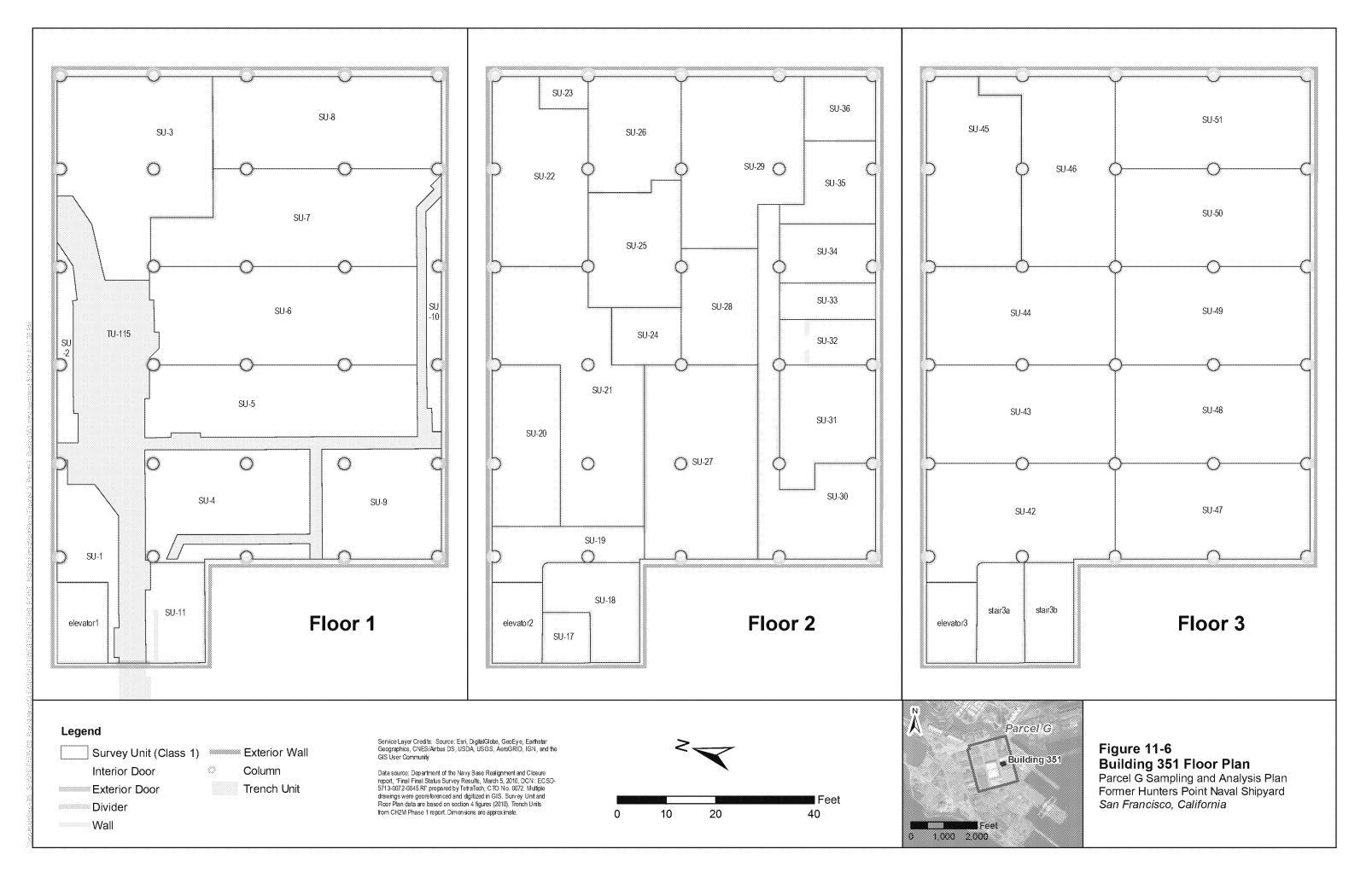
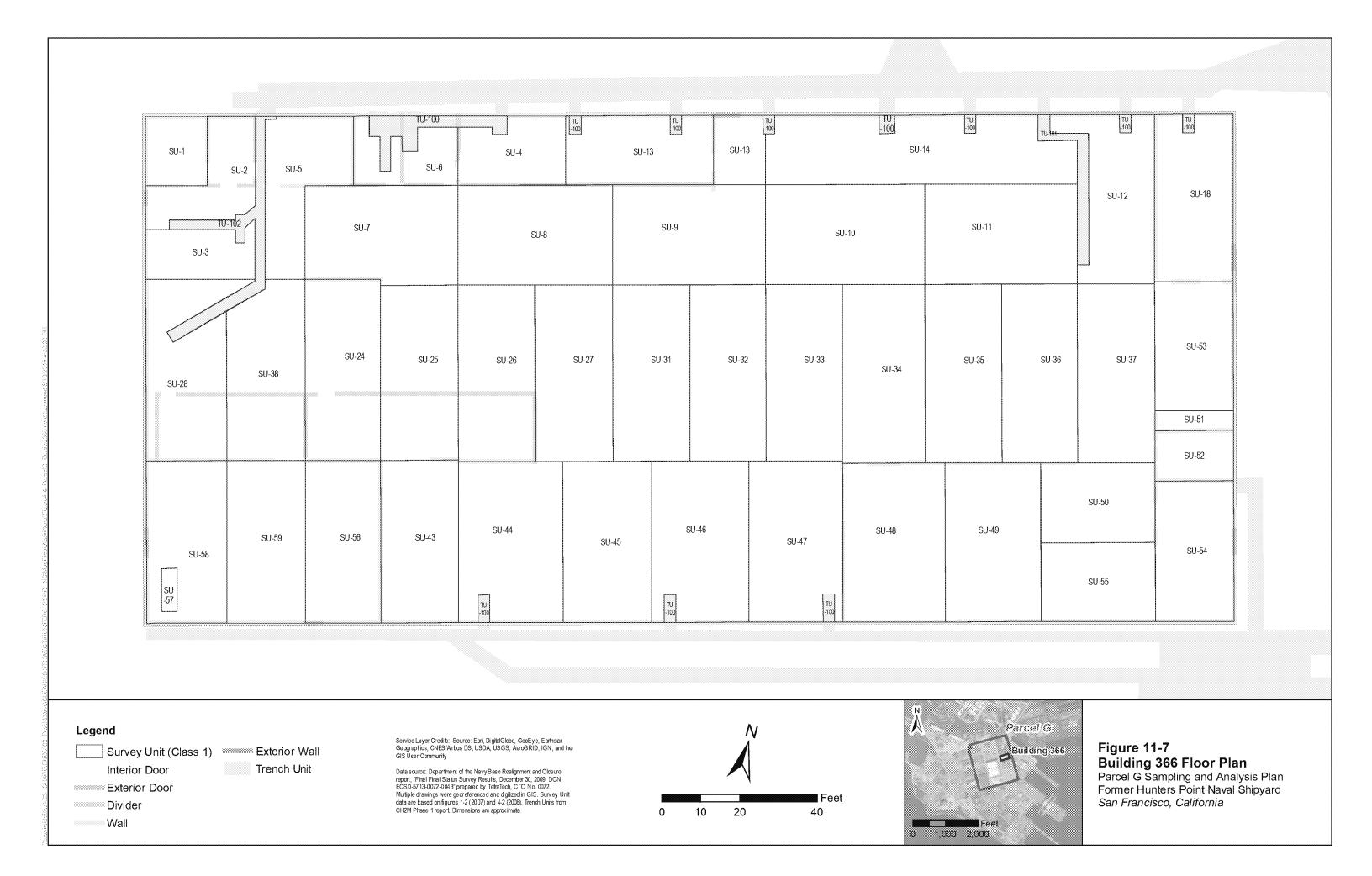
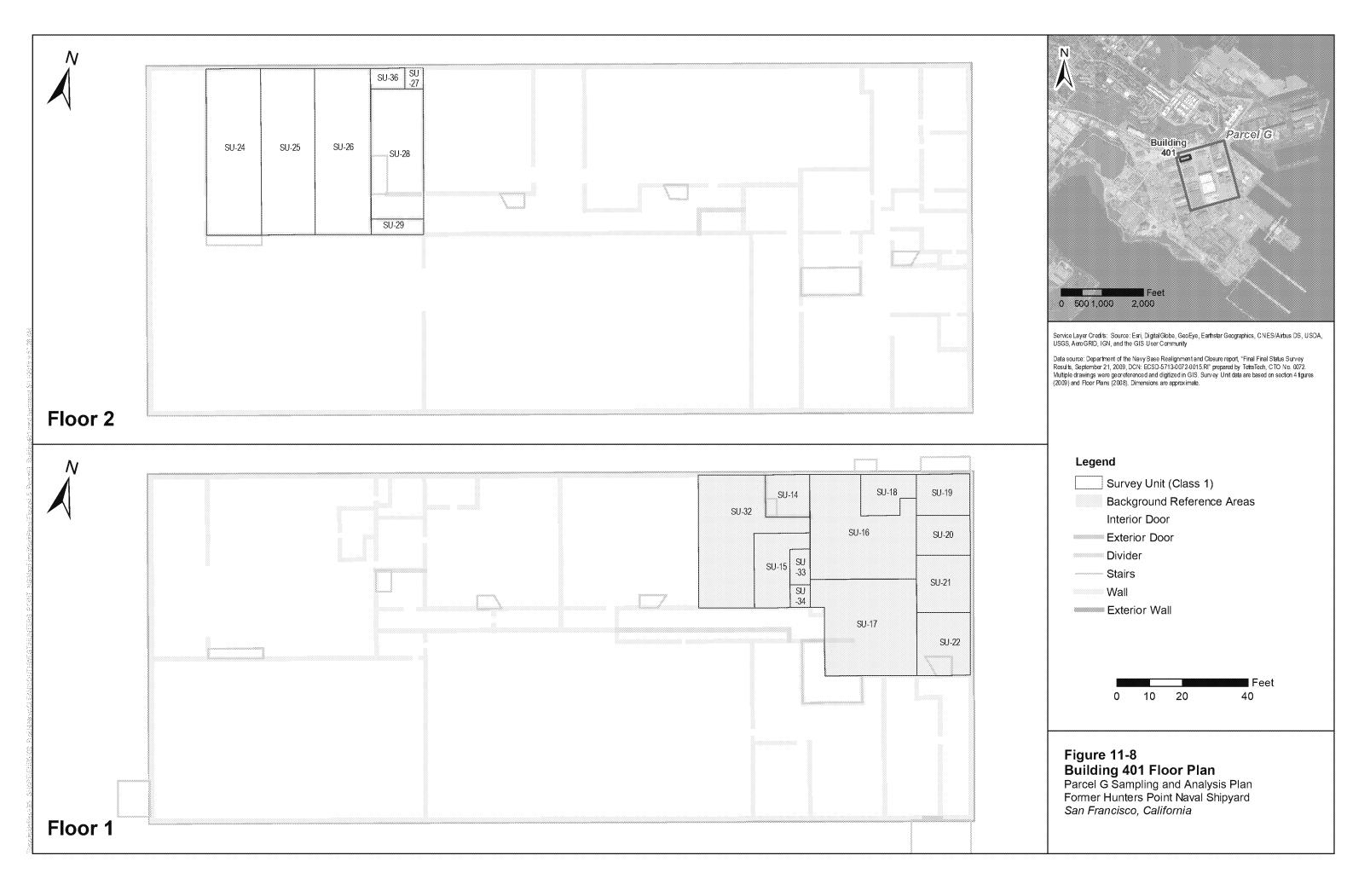


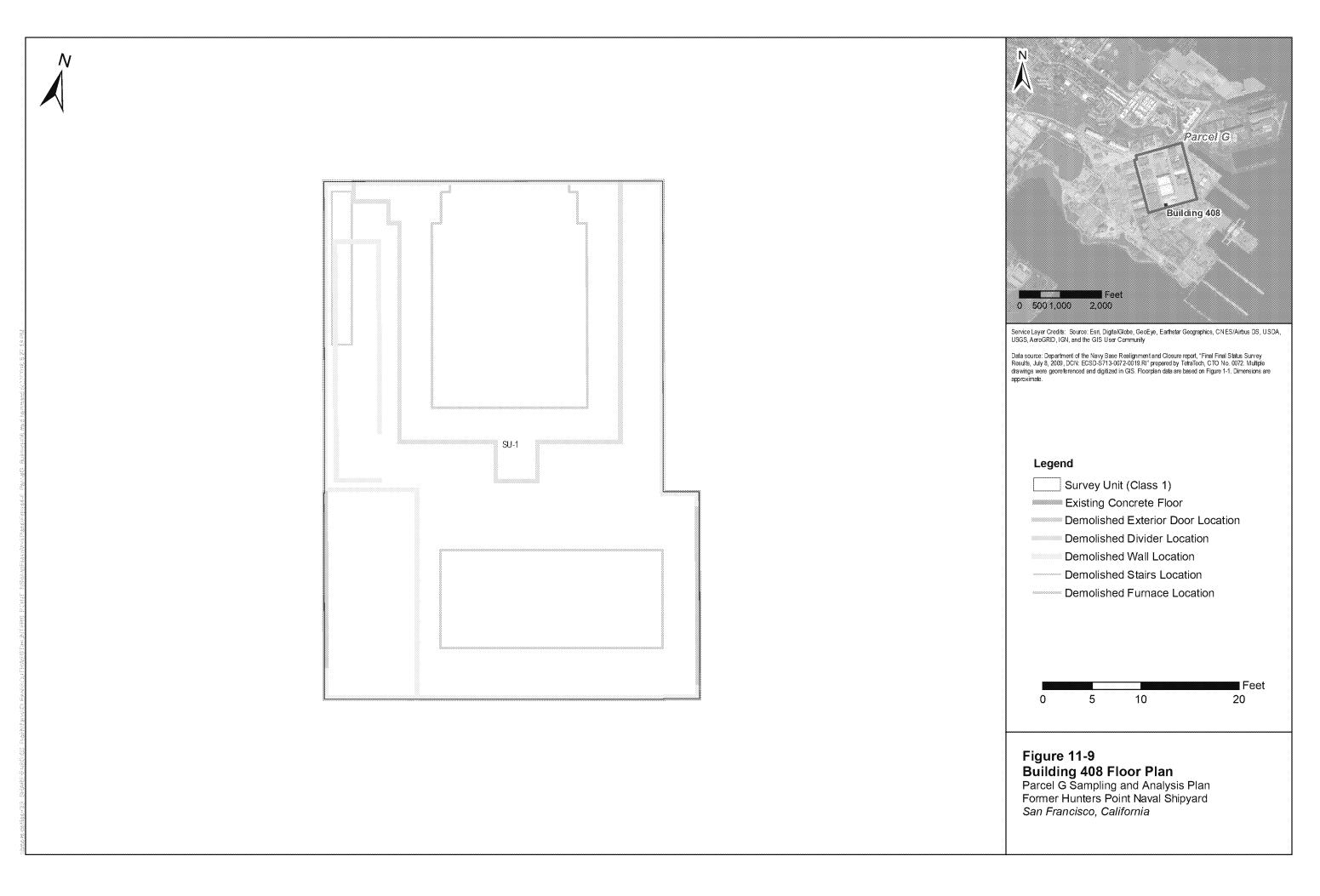
Figure 11-5
Building 351A Floor Plan
Parcel G Sampling and Analysis Plan

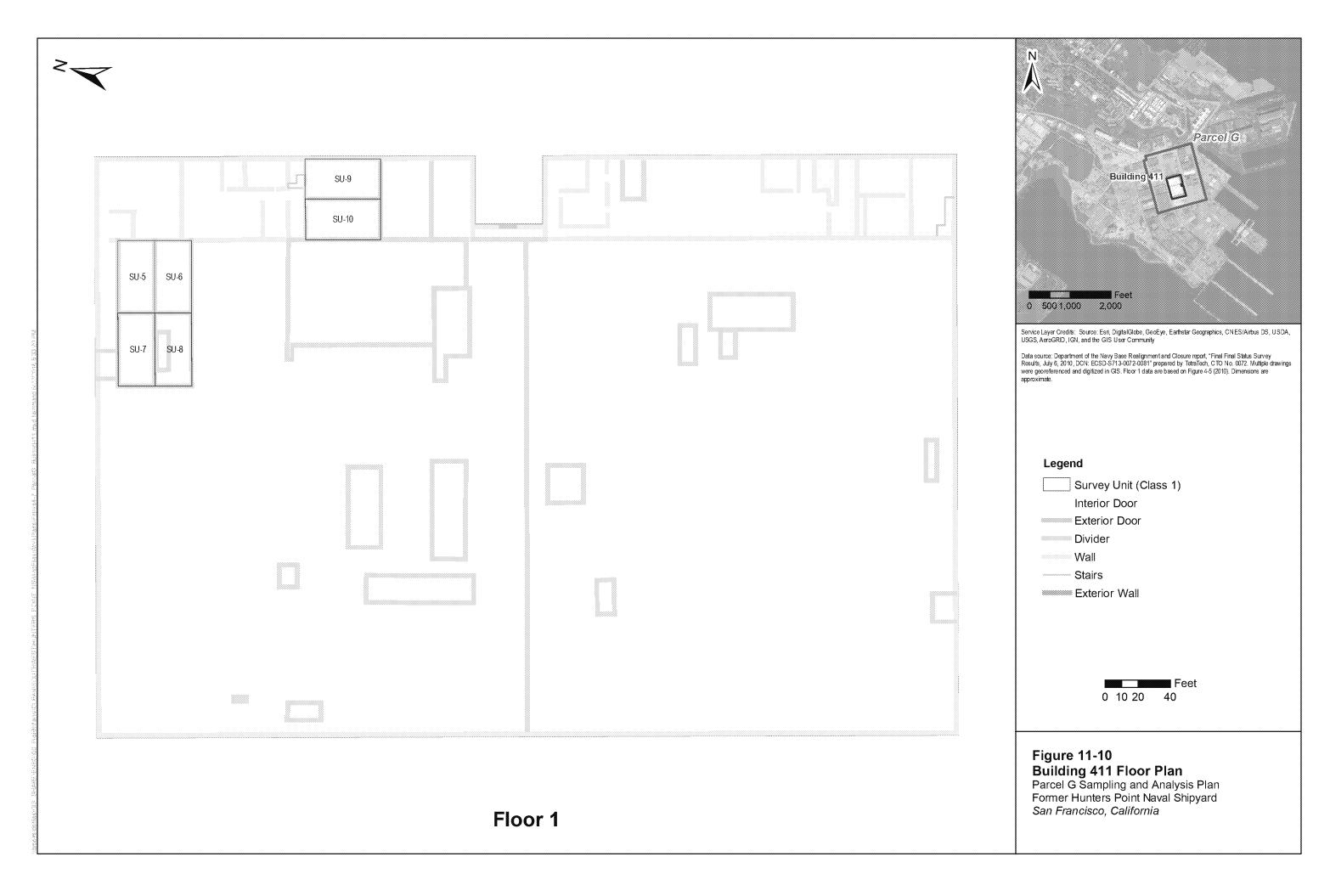
Parcel G Sampling and Analysis Plan Former Hunters Point Naval Shipyard San Francisco, California

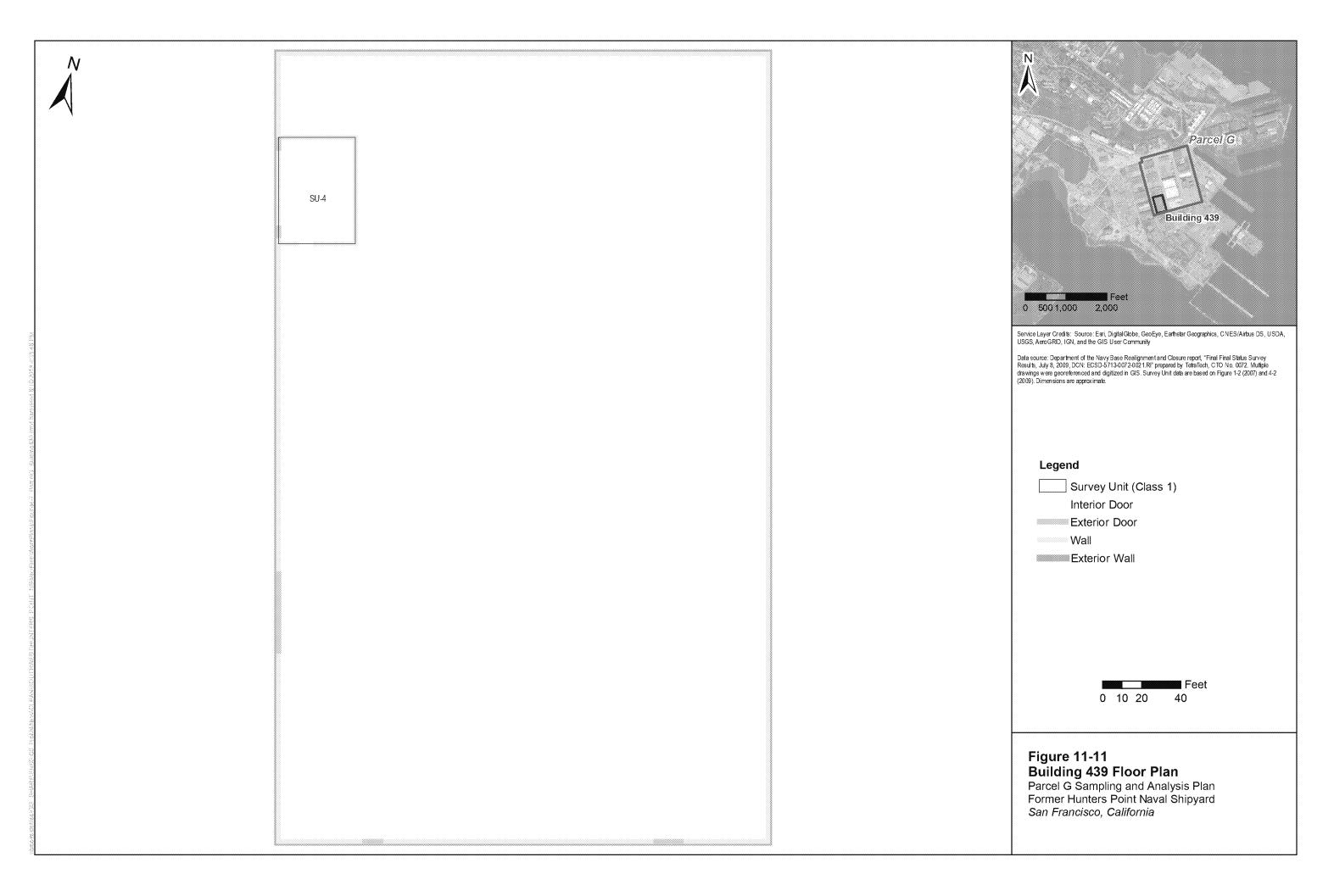


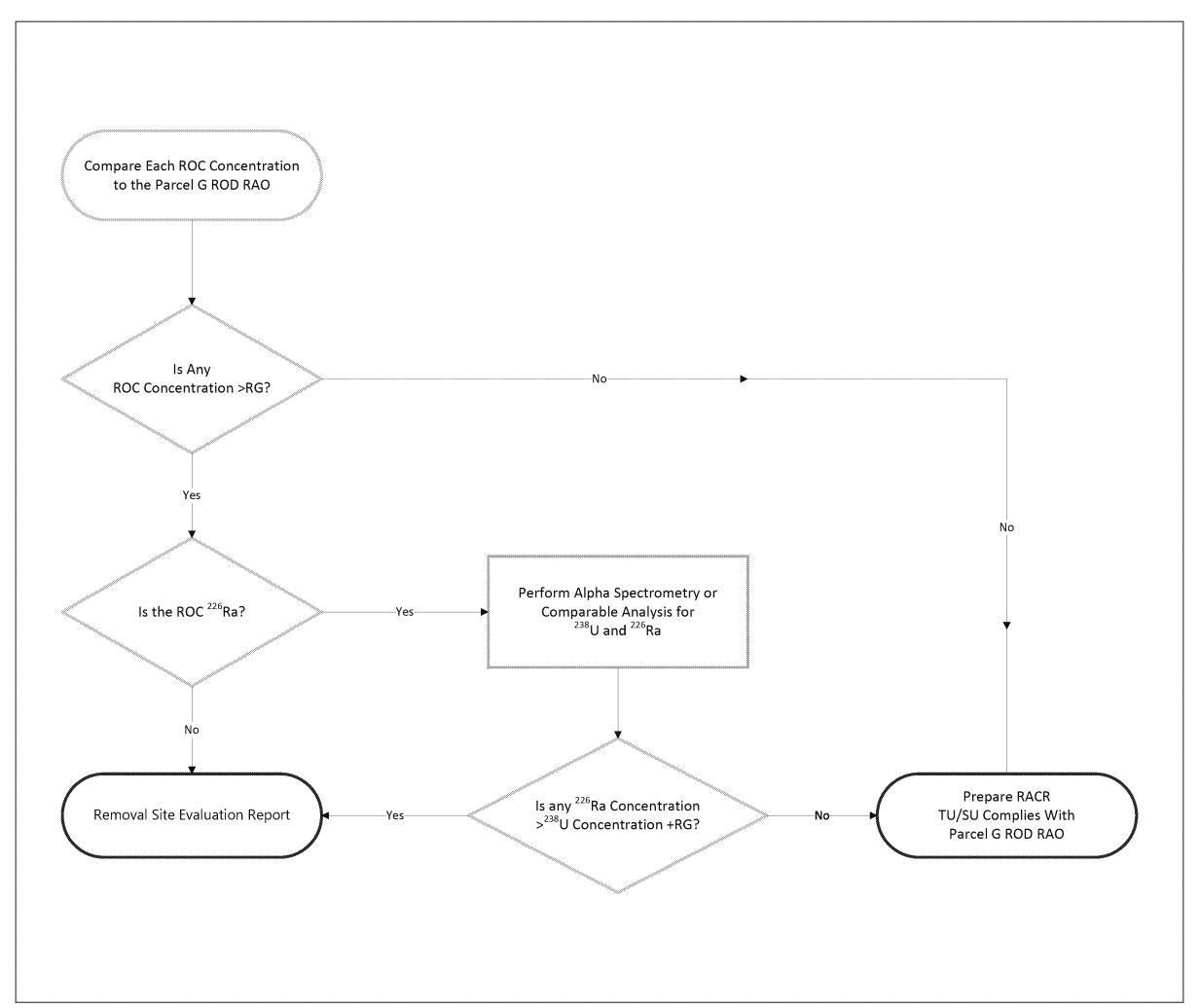












### Acronyms:

Ra = Radium

**RACR** = removal action completion report

RAO = remedial action objective

RG = remediation goal

**ROC** = radionuclide of concern

**ROD** = record of decision

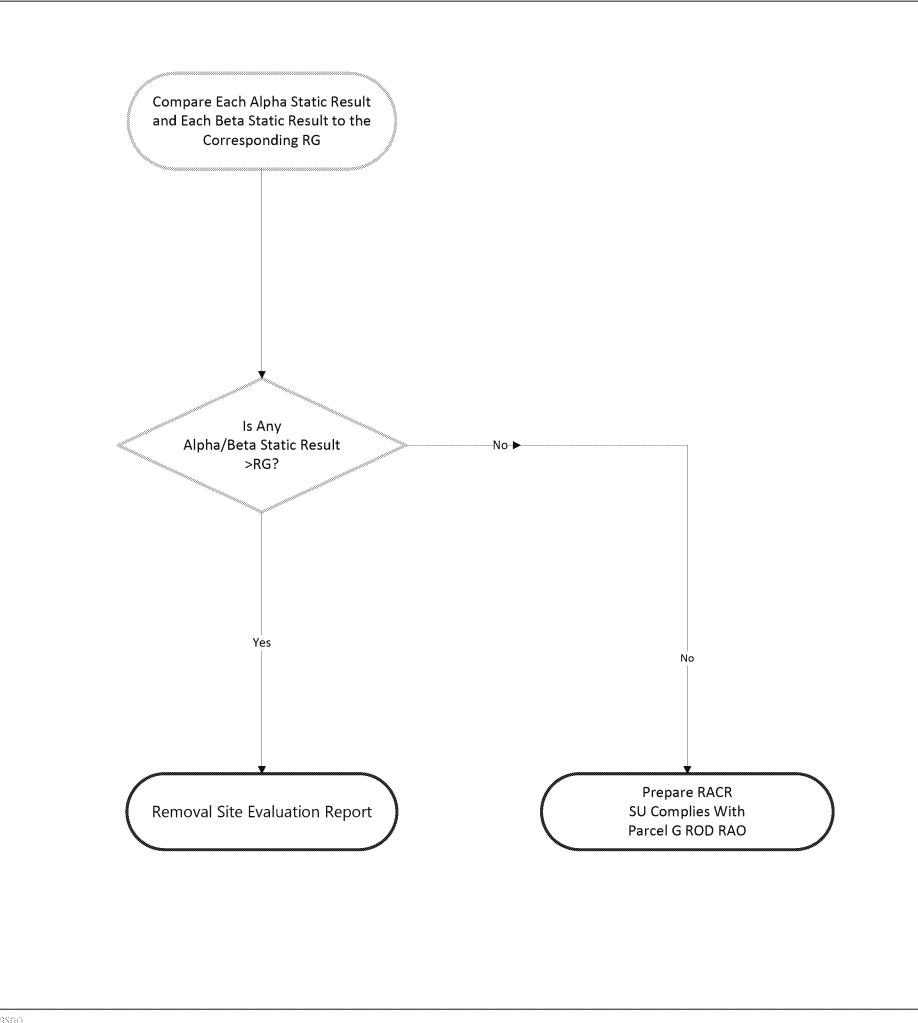
SU = survey unit

**TU** = trench unit

**U** = uranium

Figure 11-12
Performance Criteria for Demonstrating
Compliance with the Parcel G ROD – Soil

Parcel G Sampling and Analysis Plan Former Hunters Point Naval Shipyard San Francisco, California



### Acronyms:

**RACR** = removal action completion report

RAO = remedial action objective

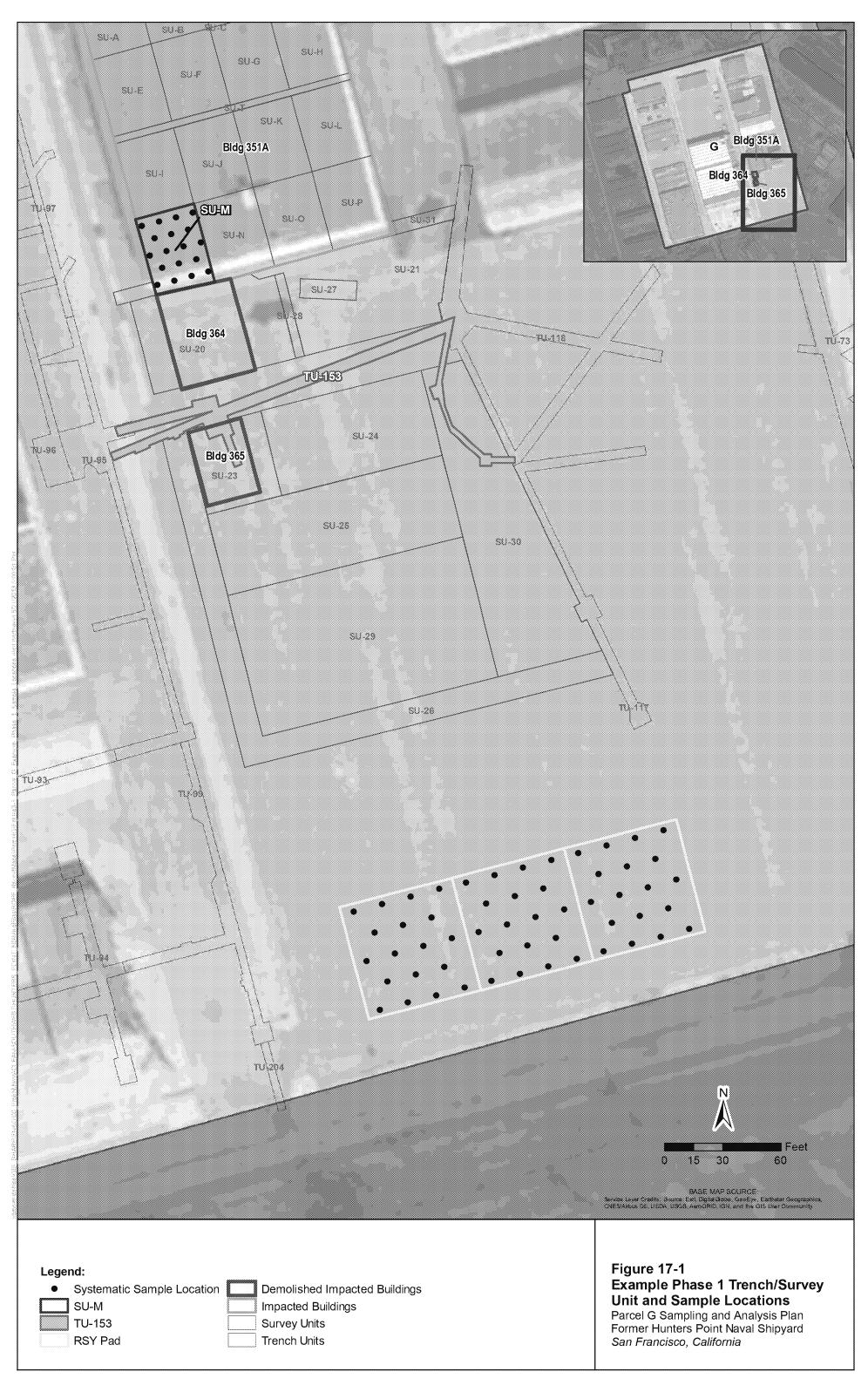
RG = remediation goal

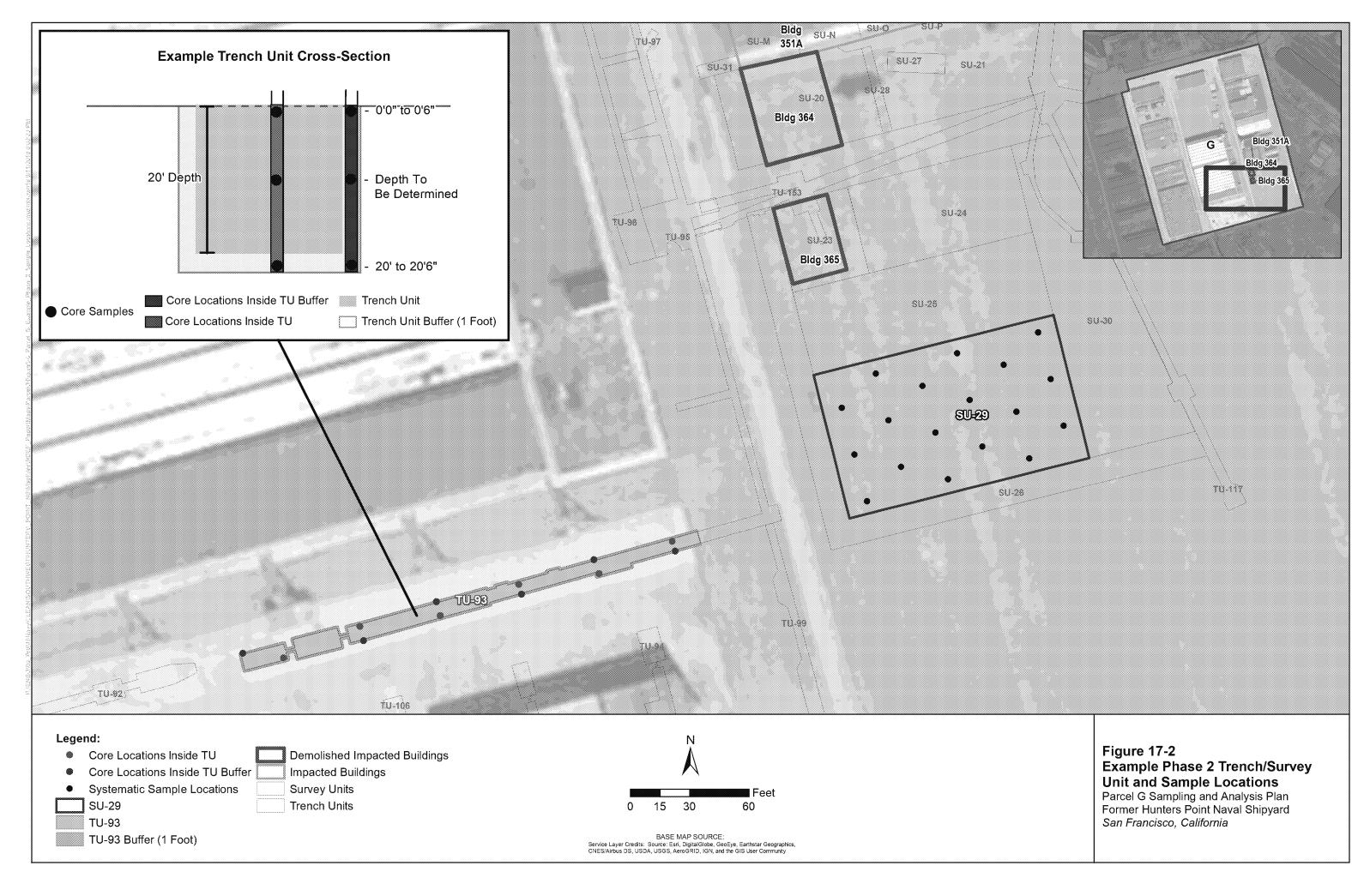
**ROD** = record of decision

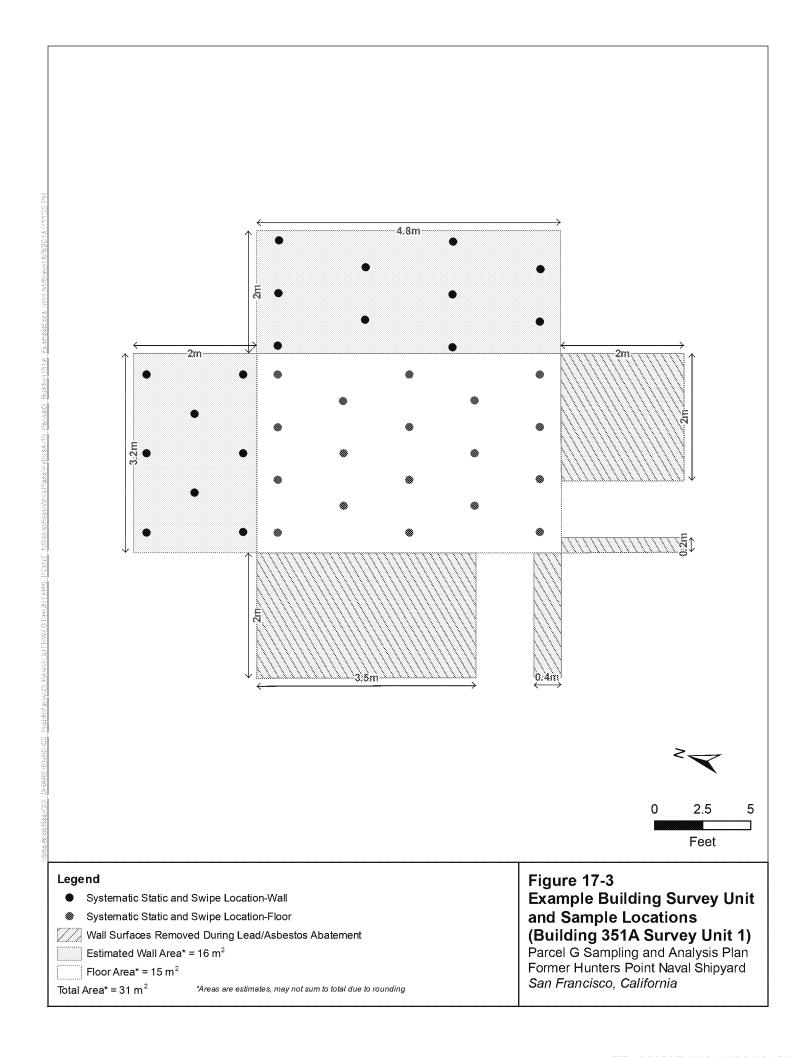
**SU =** survey unit

Figure 11-13
Performance Criteria for Demonstrating
Compliance with the Parcel G ROD –
Buildings

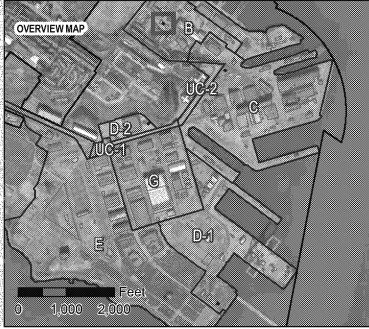
Parcel G Sampling and Analysis Plan Former Hunters Point Naval Shipyard San Francisco, California







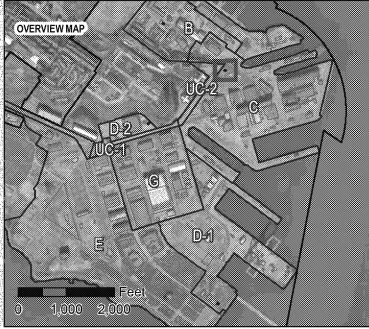




# Legend: O Sample Location Reference Background Area Installation Boundary Parcel Boundary Current and Former Building Site COORDINATE SYSTEM: NAD 1983 State Plane California III FIPS 0403 Feet BASE MAP SOURCE: Service Layer Credits: Source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 17-4 HPNS Reference Background Area RBA-1 Parcel G Sampling and Analysis Plan Former Hunters Point Naval Shipyard San Francisco, California

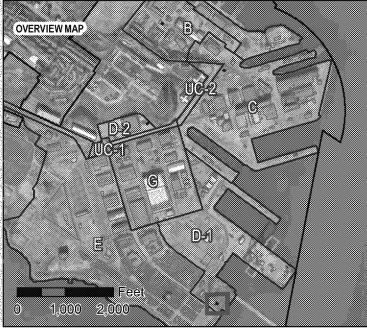




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HPNS Reference Background Area RBA-2 Parcel G Sampling and Analysis Plan Former Hunters Point Naval Shipyard San Francisco, California

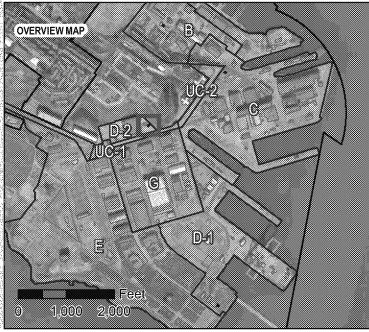




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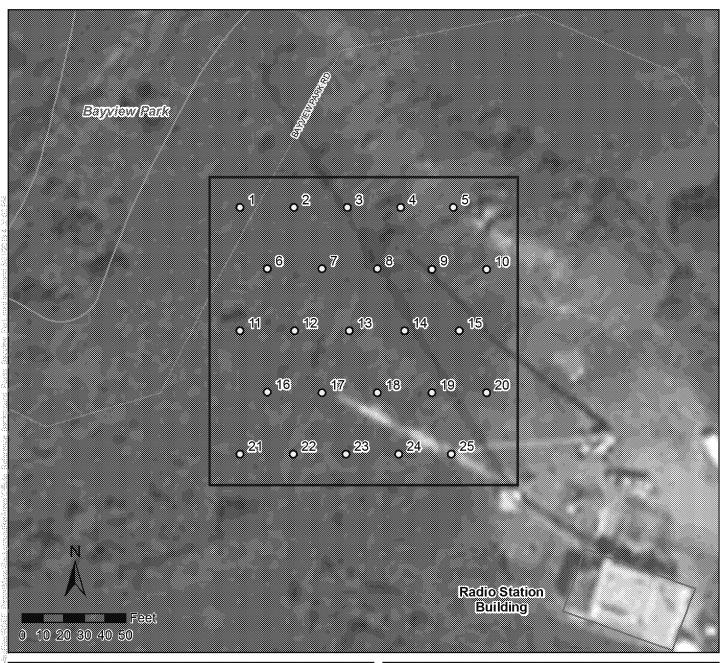
Figure 17-6 HPNS Reference Background Area RBA-3 Parcel G Sampling and Analysis Plan Former Hunters Point Naval Shipyard San Francisco, California

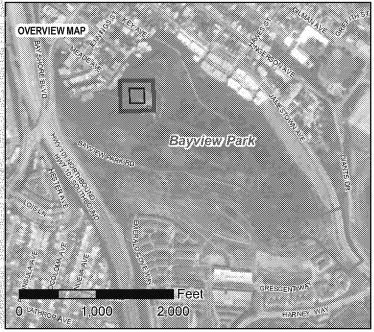




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HPNS Reference Background Area RBA-4
Parcel G Sampling and Analysis Plan
Former Hunters Point Naval Shipyard
San Francisco, California





# Legend: O Sample Location Reference Background Area Park Building COORDINATE SYSTEM: NAD 1983 StatePlane California III FIPS 0403 Feet BASE MAP SOURCE: Service Layer Credits: Source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Park Lands layer developed by the San Francisco Recreation and Parks Department (2016). Figure 17-8 Bayview Park Reference Background Area RBA-Bayview Parcel G Sampling and Analysis Plan Former Hunters Point Naval Shipyard

San Francisco, California